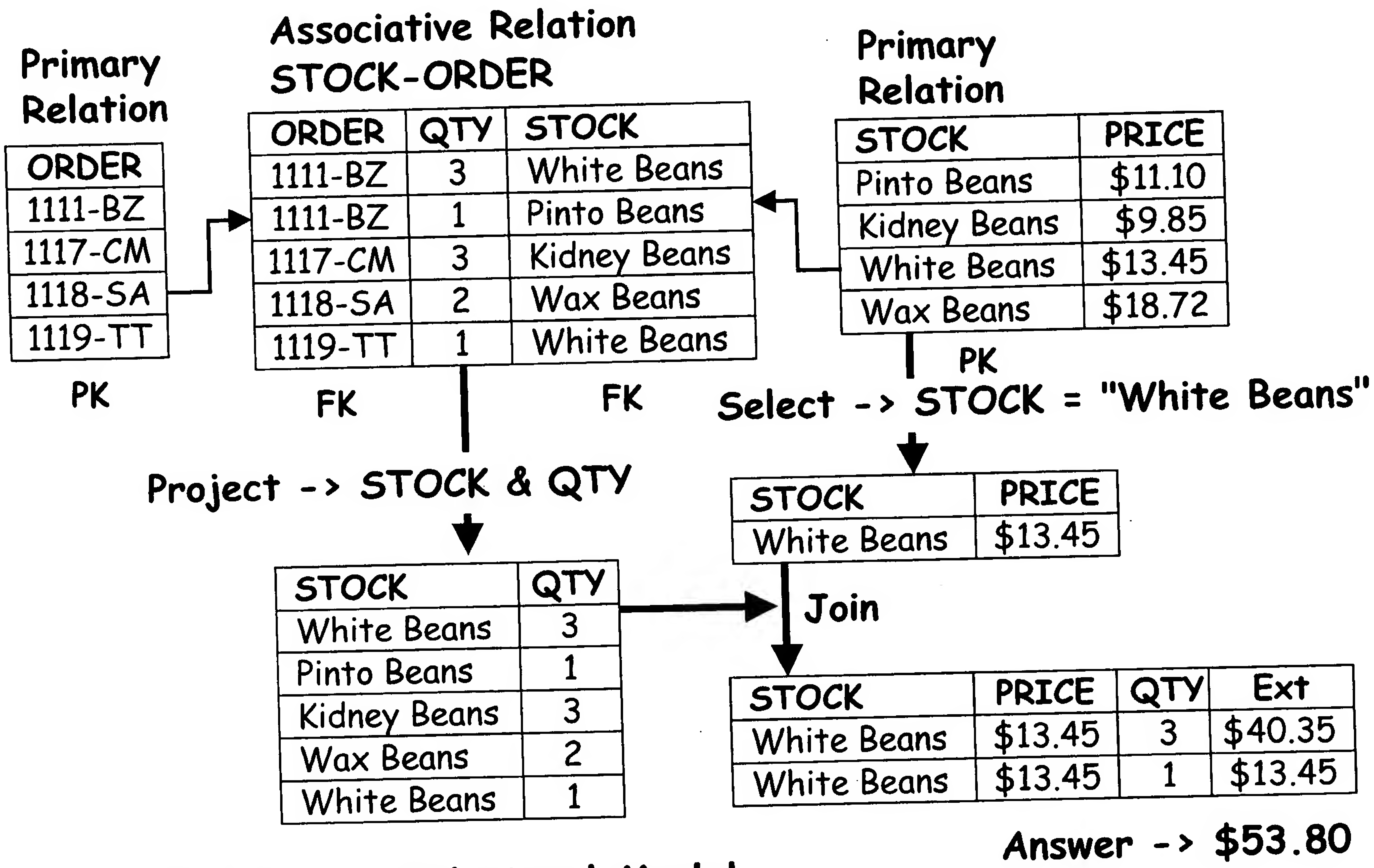
What is the total PRICE of 'White Beans' on all STOCK-ORDERs?



Primary Relation

ORDER
1111-BZ
1117-CM
1118-SA
1119-TT

PK

Associative Relation STOCK-ORDER

ORDER	QTY	STOCK
1111-BZ	3	White Beans
1111-BZ	1	Pinto Beans
1117-CM	3	Kidney Beans
1118-SA	2	Wax Beans
1119-TT	1	White Beans

FK FK

Primary Relation

STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

PK

Project -> STOCK & QTY

STOCK	QTY
White Beans	3
Pinto Beans	1
Kidney Beans	3
Wax Beans	2
White Beans	1

Select -> STOCK = "White Beans"

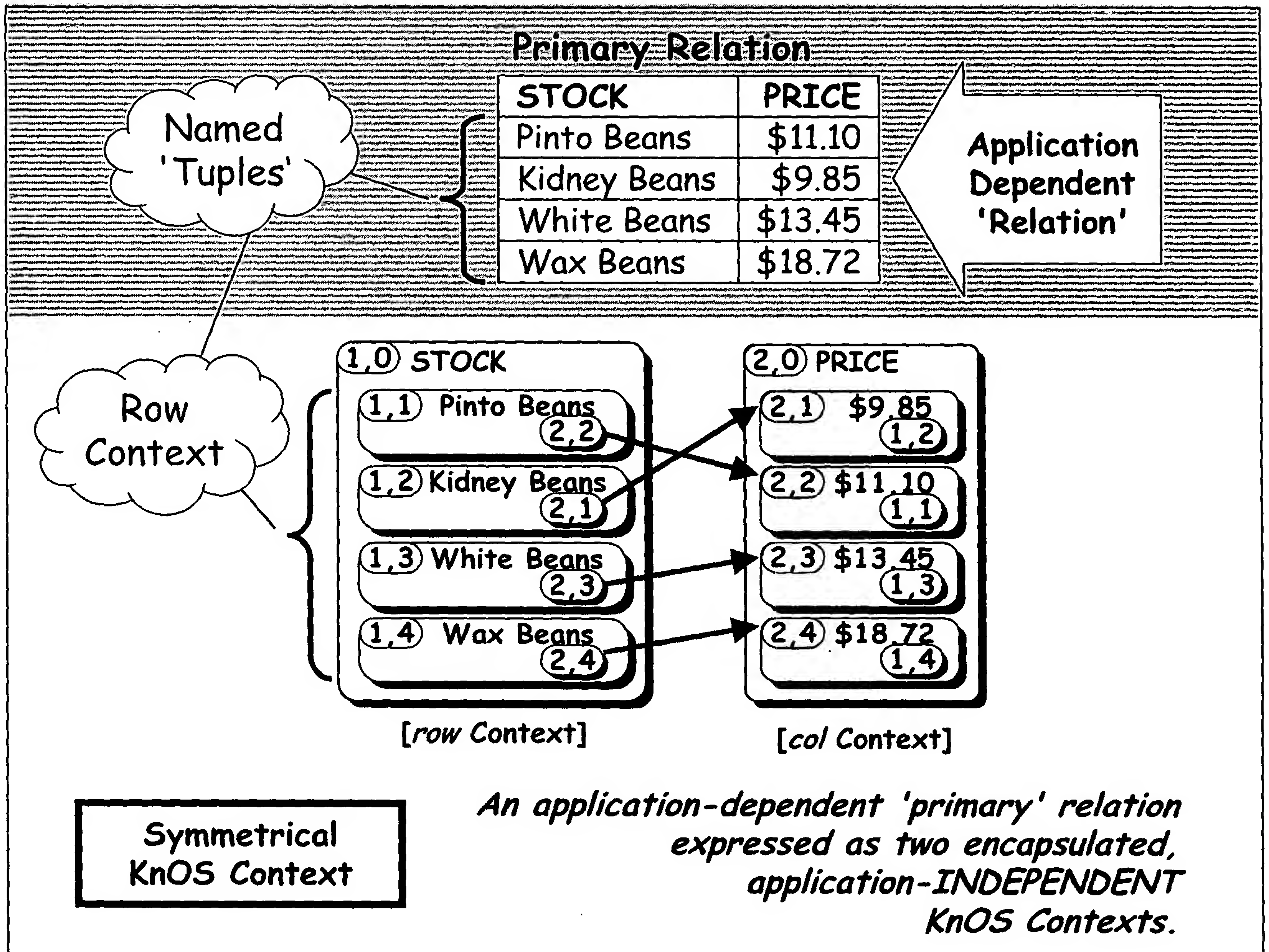
STOCK	PRICE
White Beans	$13.45

Join

STOCK	PRICE	QTY	Ext
White Beans	$13.45	3	$40.35
White Beans	$13.45	1	$13.45

Answer -> $53.80

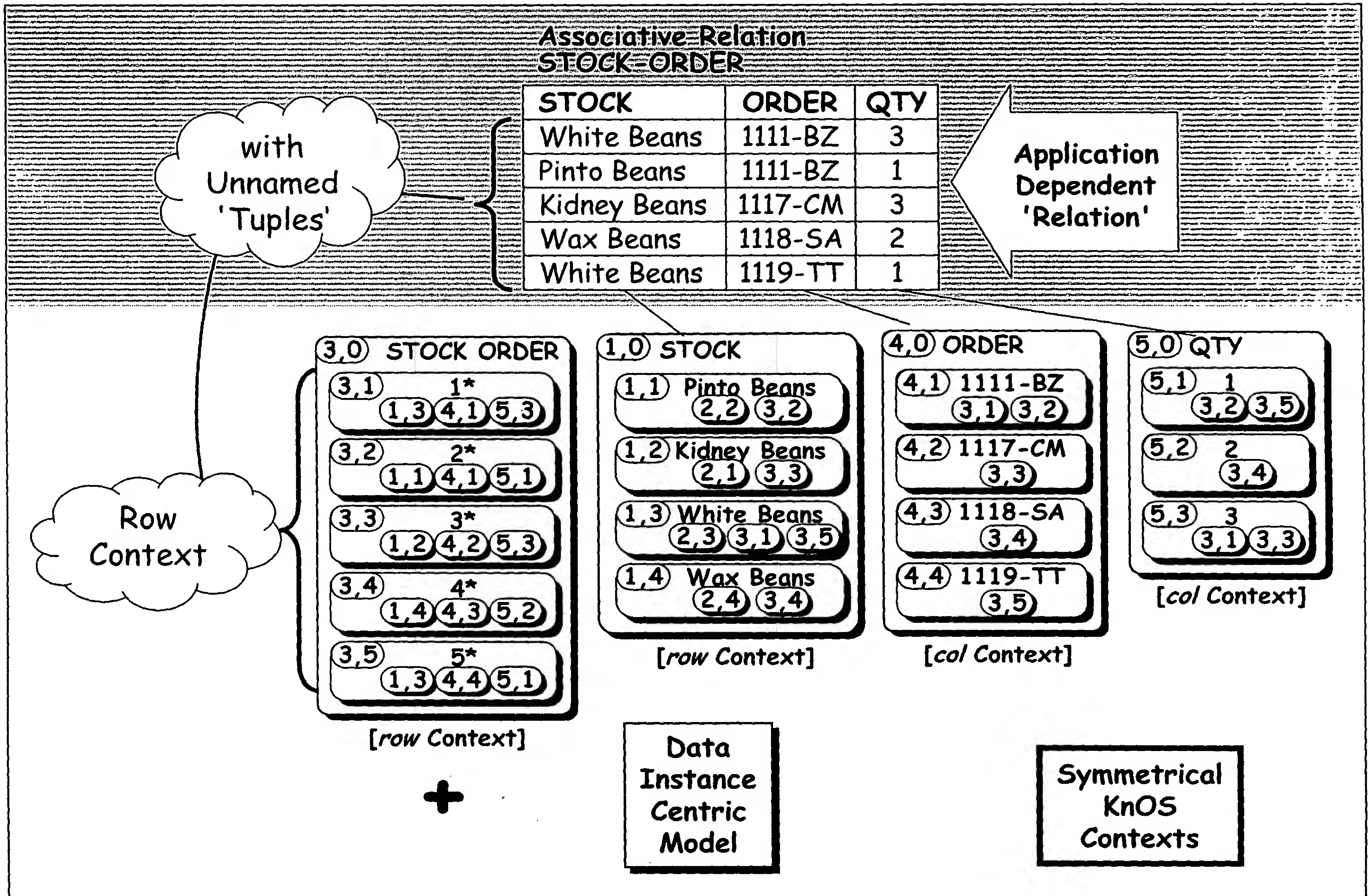
Drawing 1. Relational Model



STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

An application-dependent 'primary' relation expressed as two encapsulated, application-INDEPENDENT KnOS Contexts.

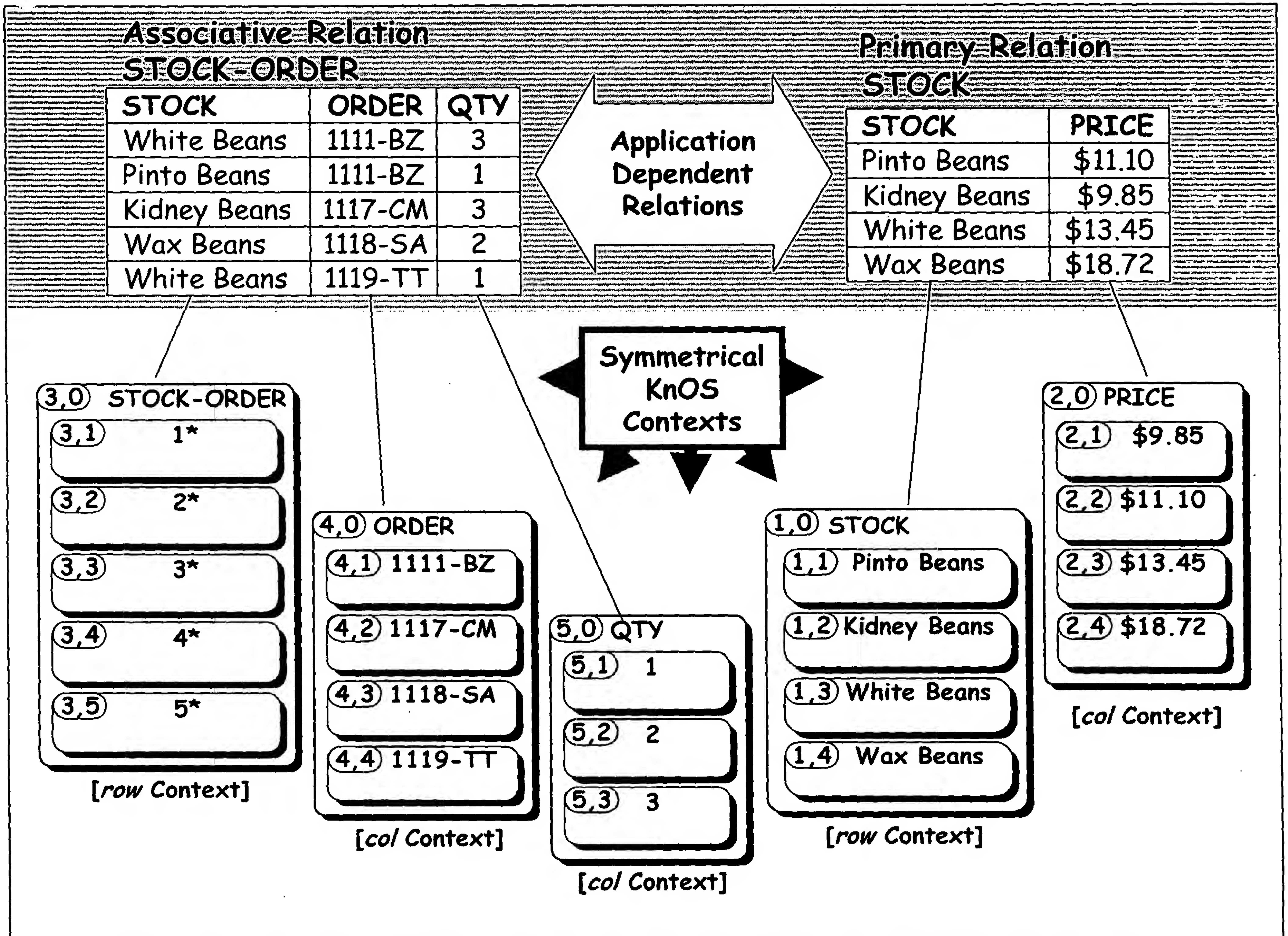
Drawing 2. Assimilating a 'Primary' Relation



Associative Relation
STOCK-ORDER

STOCK	ORDER	QTY
White Beans	1111-BZ	3
Pinto Beans	1111-BZ	1
Kidney Beans	1117-CM	3
Wax Beans	1118-SA	2
White Beans	1119-TT	1

Drawing 3. Assimilating an 'Associative' Relation



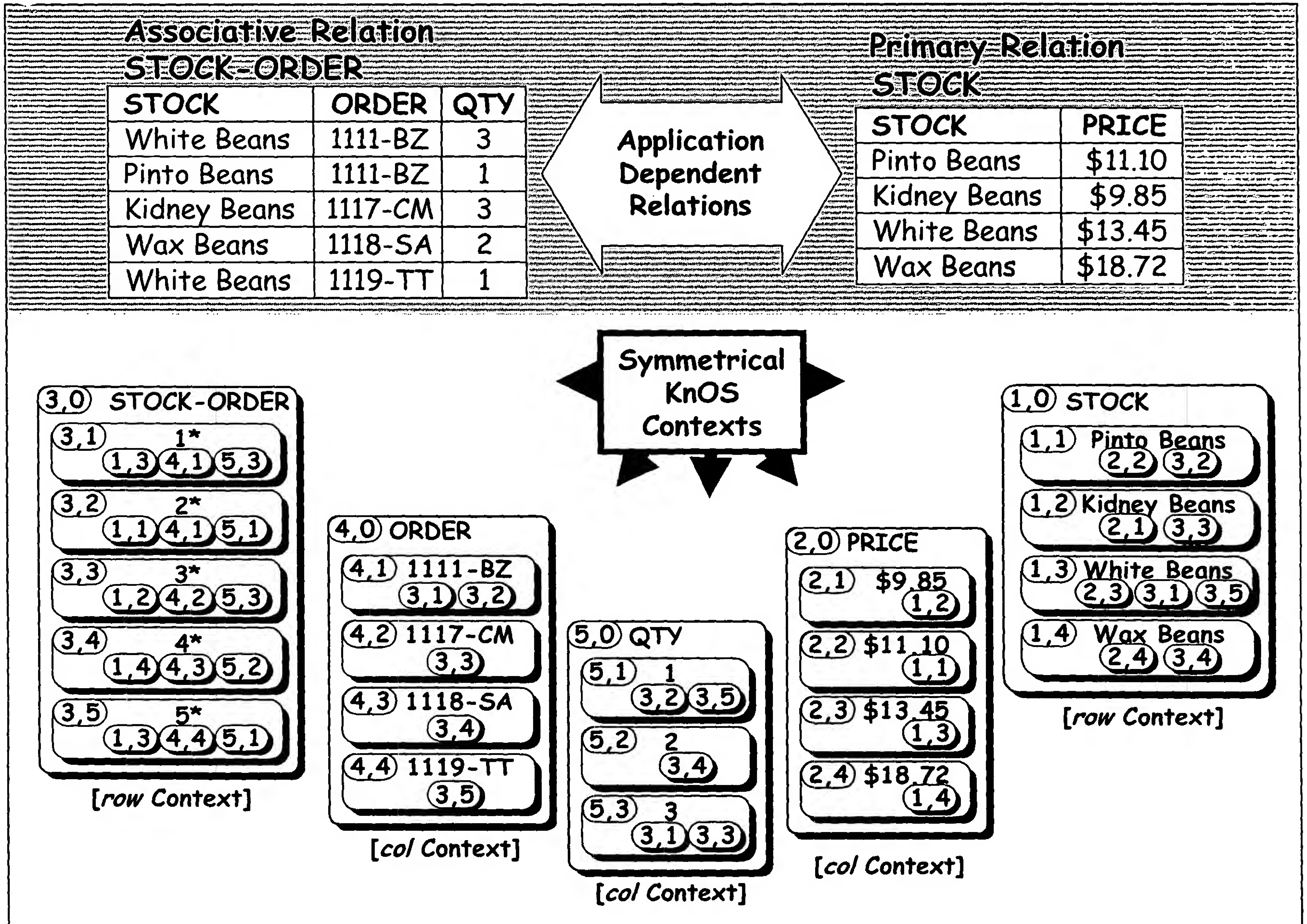
Associative Relation
STOCK-ORDER

STOCK	ORDER	QTY
White Beans	1111-BZ	3
Pinto Beans	1111-BZ	1
Kidney Beans	1117-CM	3
Wax Beans	1118-SA	2
White Beans	1119-TT	1

Primary Relation
STOCK

STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

Drawing 4. Projection of Rows & Columns to KnOS Contexts



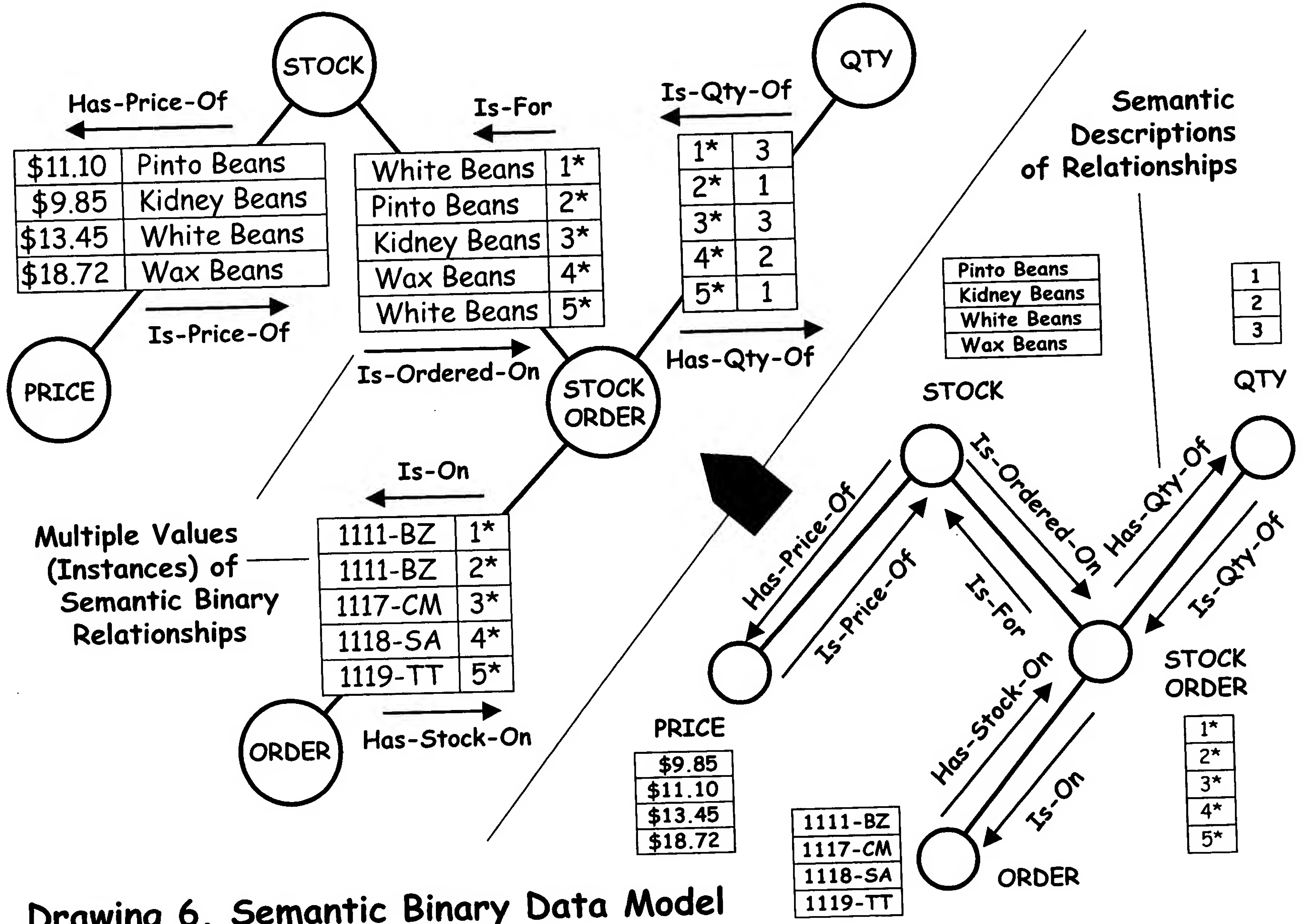
Associative Relation
STOCK-ORDER

STOCK	ORDER	QTY
White Beans	1111-BZ	3
Pinto Beans	1111-BZ	1
Kidney Beans	1117-CM	3
Wax Beans	1118-SA	2
White Beans	1119-TT	1

Primary Relation
STOCK

STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

Drawing 5. Assimilation of Relationships to KnOS Contexts



$11.10	Pinto Beans
$9.85	Kidney Beans
$13.45	White Beans
$18.72	Wax Beans

White Beans	1*
Pinto Beans	2*
Kidney Beans	3*
Wax Beans	4*
White Beans	5*

1*	3
2*	1
3*	3
4*	2
5*	1

1111-BZ	1*
1111-BZ	2*
1117-CM	3*
1118-SA	4*
1119-TT	5*

STOCK
Pinto Beans
Kidney Beans
White Beans
Wax Beans

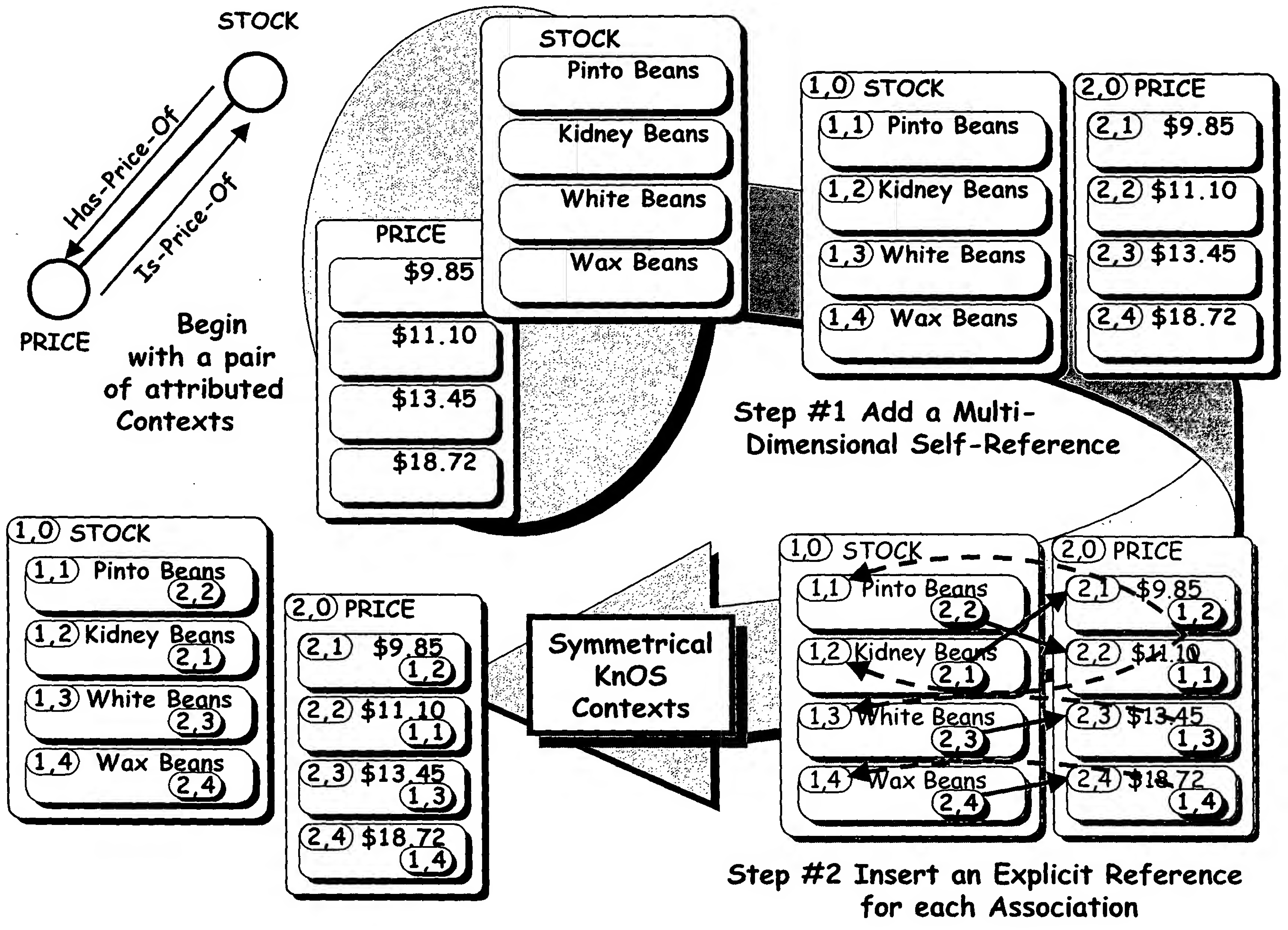
QTY
1
2
3

PRICE
$9.85
$11.10
$13.45
$18.72

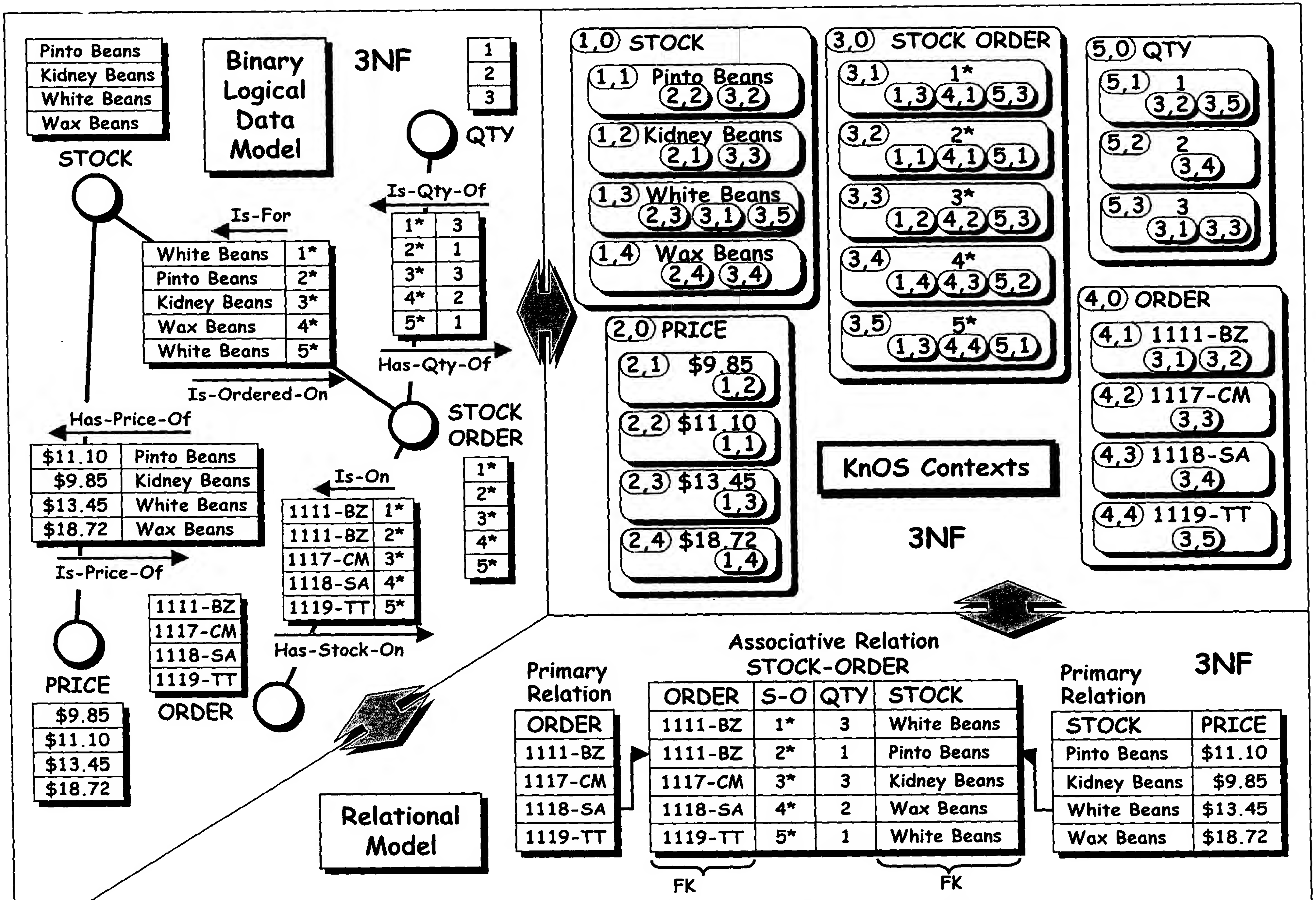
ORDER
1111-BZ
1117-CM
1118-SA
1119-TT

STOCK ORDER
1*
2*
3*
4*
5*

Drawing 6. Semantic Binary Data Model



Drawing 7. Representing Binary Associations in KnOS Contexts



STOCK

Pinto Beans
Kidney Beans
White Beans
Wax Beans

QTY

1
2
3

Is-For

White Beans	1*
Pinto Beans	2*
Kidney Beans	3*
Wax Beans	4*
White Beans	5*

Is-Qty-Of / Has-Qty-Of

1*	3
2*	1
3*	3
4*	2
5*	1

STOCK ORDER

1*
2*
3*
4*
5*

Has-Price-Of / Is-Price-Of

$11.10	Pinto Beans
$9.85	Kidney Beans
$13.45	White Beans
$18.72	Wax Beans

Is-On / Has-Stock-On

1111-BZ	1*
1111-BZ	2*
1117-CM	3*
1118-SA	4*
1119-TT	5*

ORDER

1111-BZ
1117-CM
1118-SA
1119-TT

PRICE

$9.85
$11.10
$13.45
$18.72

Primary Relation

ORDER
1111-BZ
1117-CM
1118-SA
1119-TT

Associative Relation STOCK-ORDER

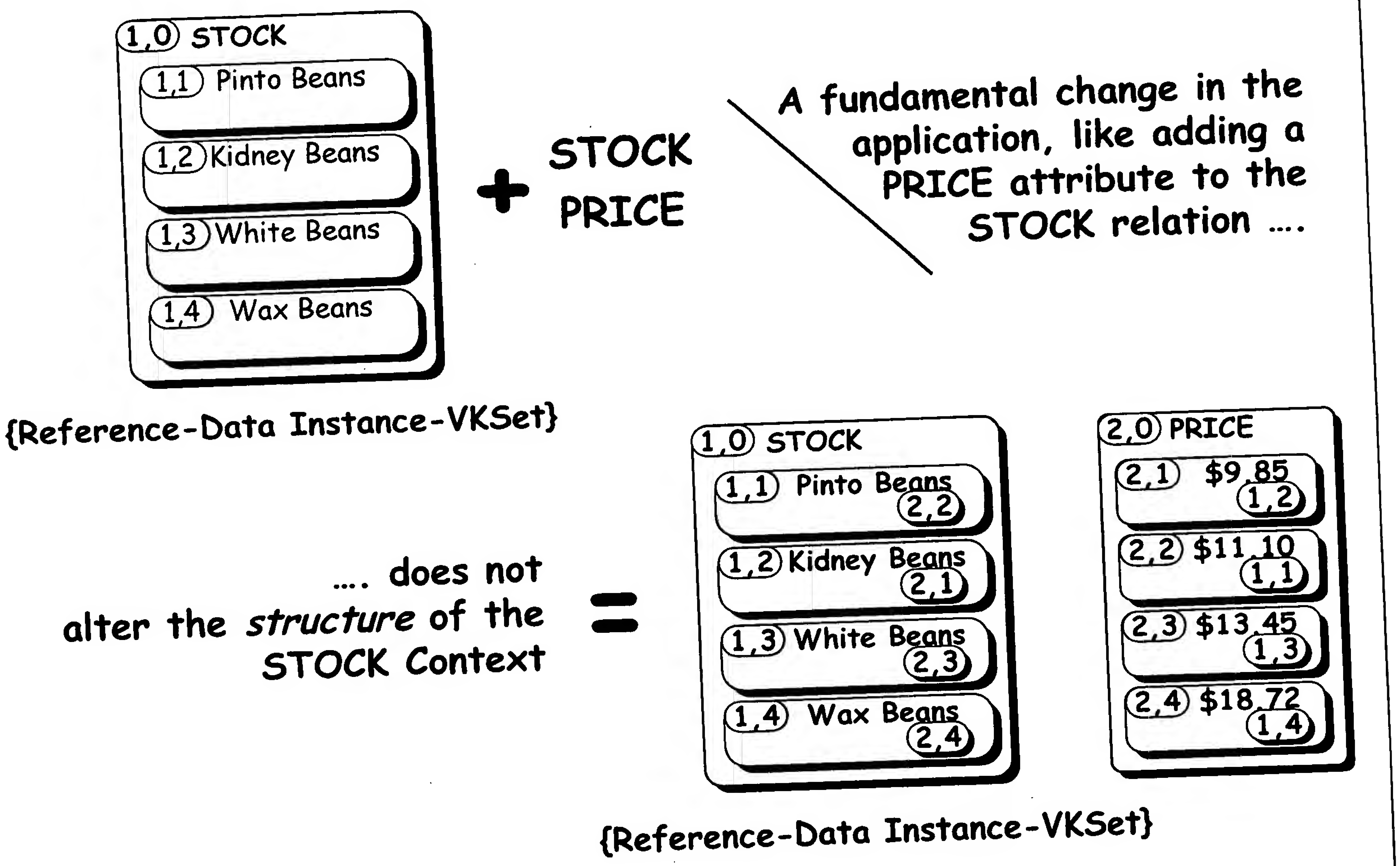
ORDER	S-O	QTY	STOCK
1111-BZ	1*	3	White Beans
1111-BZ	2*	1	Pinto Beans
1117-CM	3*	3	Kidney Beans
1118-SA	4*	2	Wax Beans
1119-TT	5*	1	White Beans

Primary Relation

STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

Drawing 8. Comparison of Data Representations

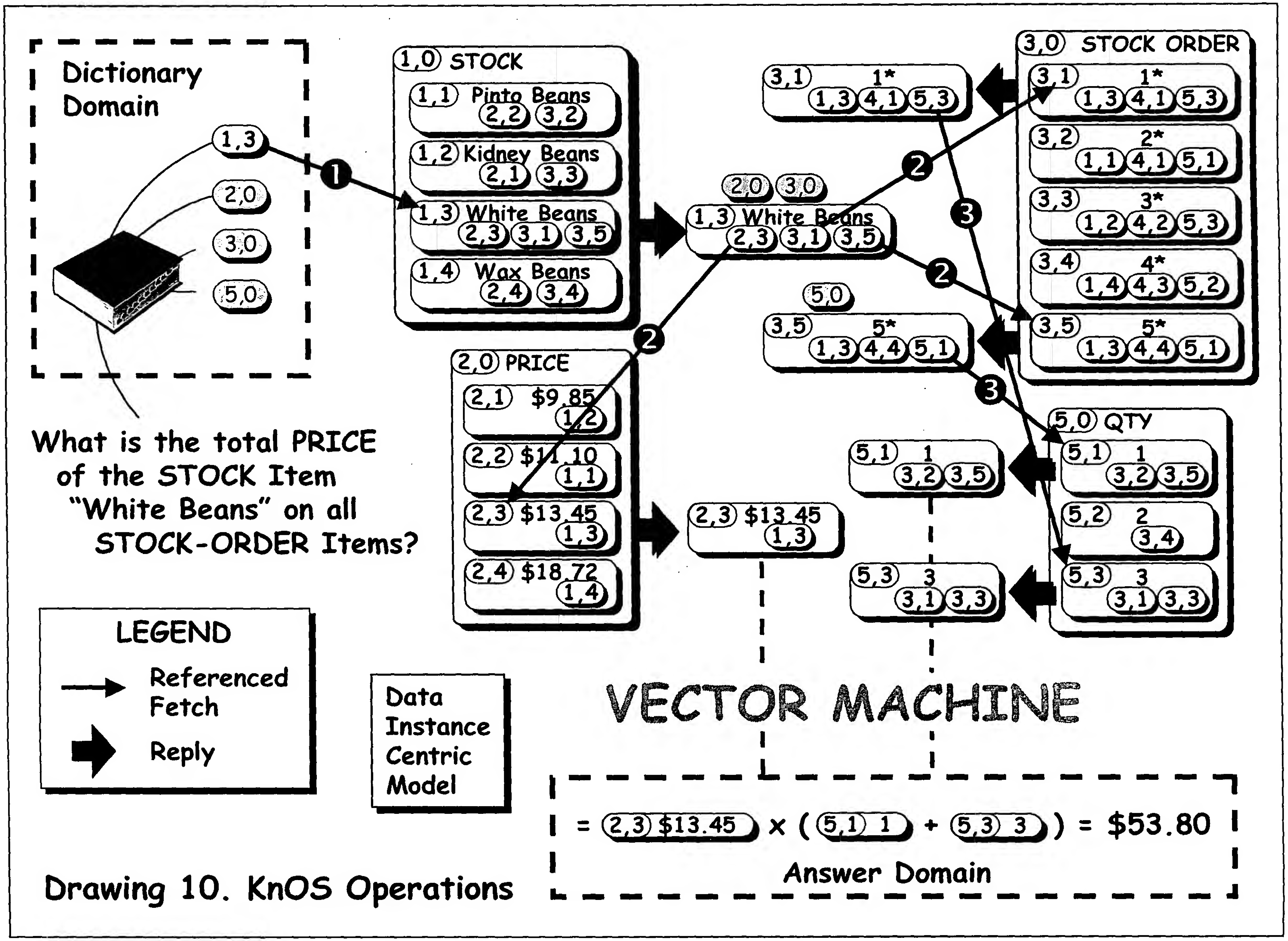
Why is a KnOS Context *Application Independent?*



A fundamental change in the application, like adding a PRICE attribute to the STOCK relation ....

.... does not alter the *structure* of the STOCK Context

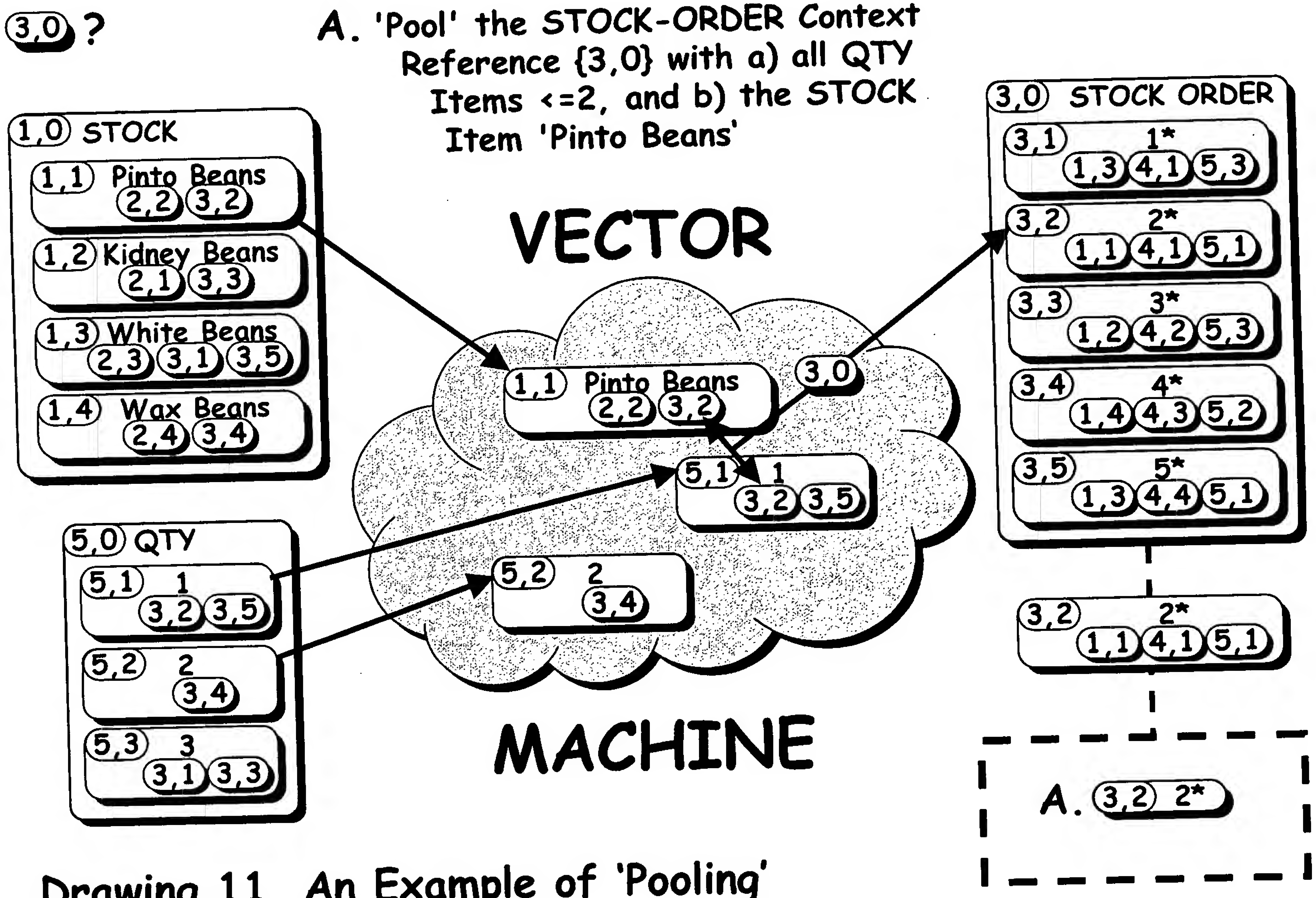
Drawing 9. Application Independence



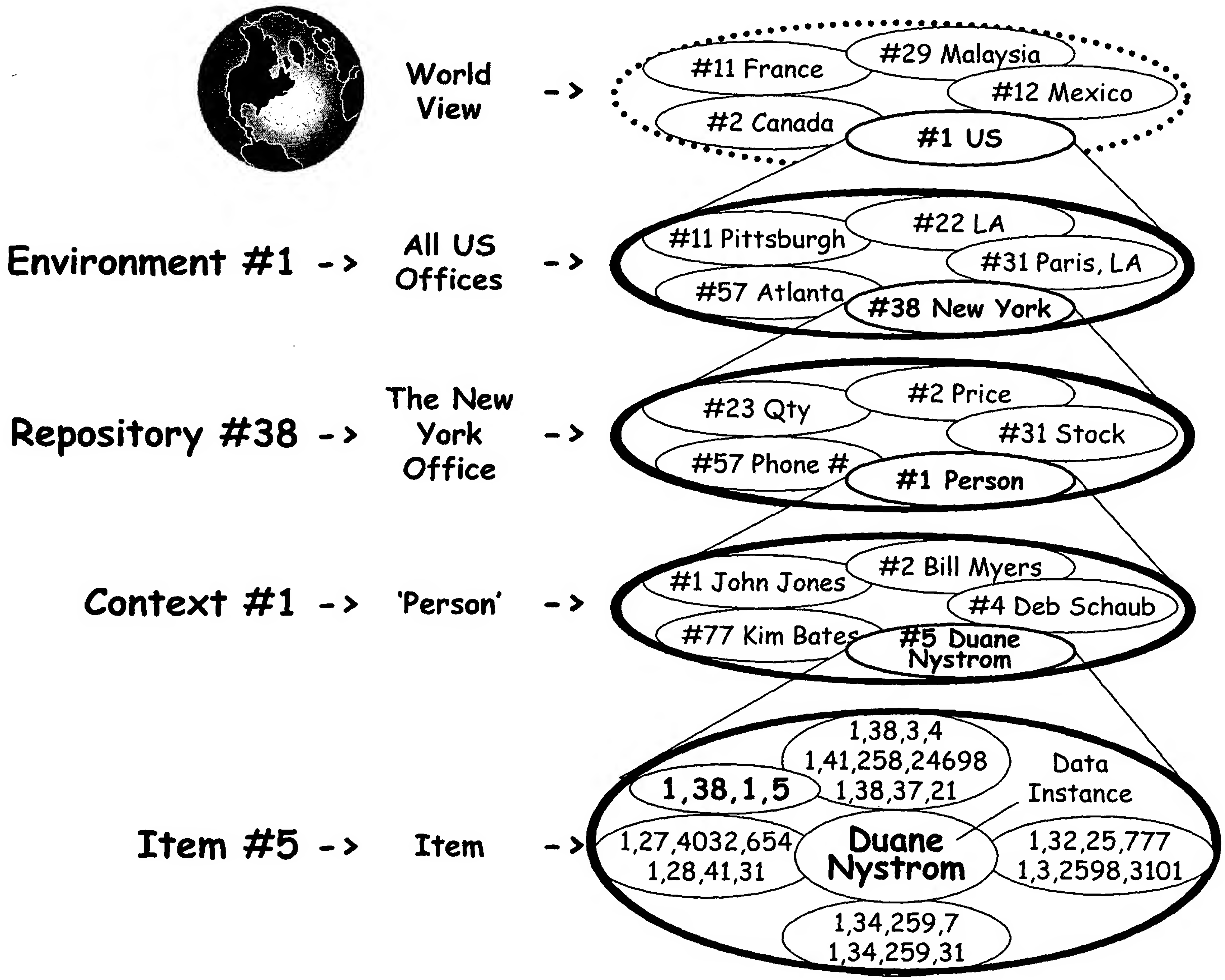
Drawing 10. KnOS Operations

Q. Which STOCK-ORDER Items for "Pinto Beans" have a QTY <= 2

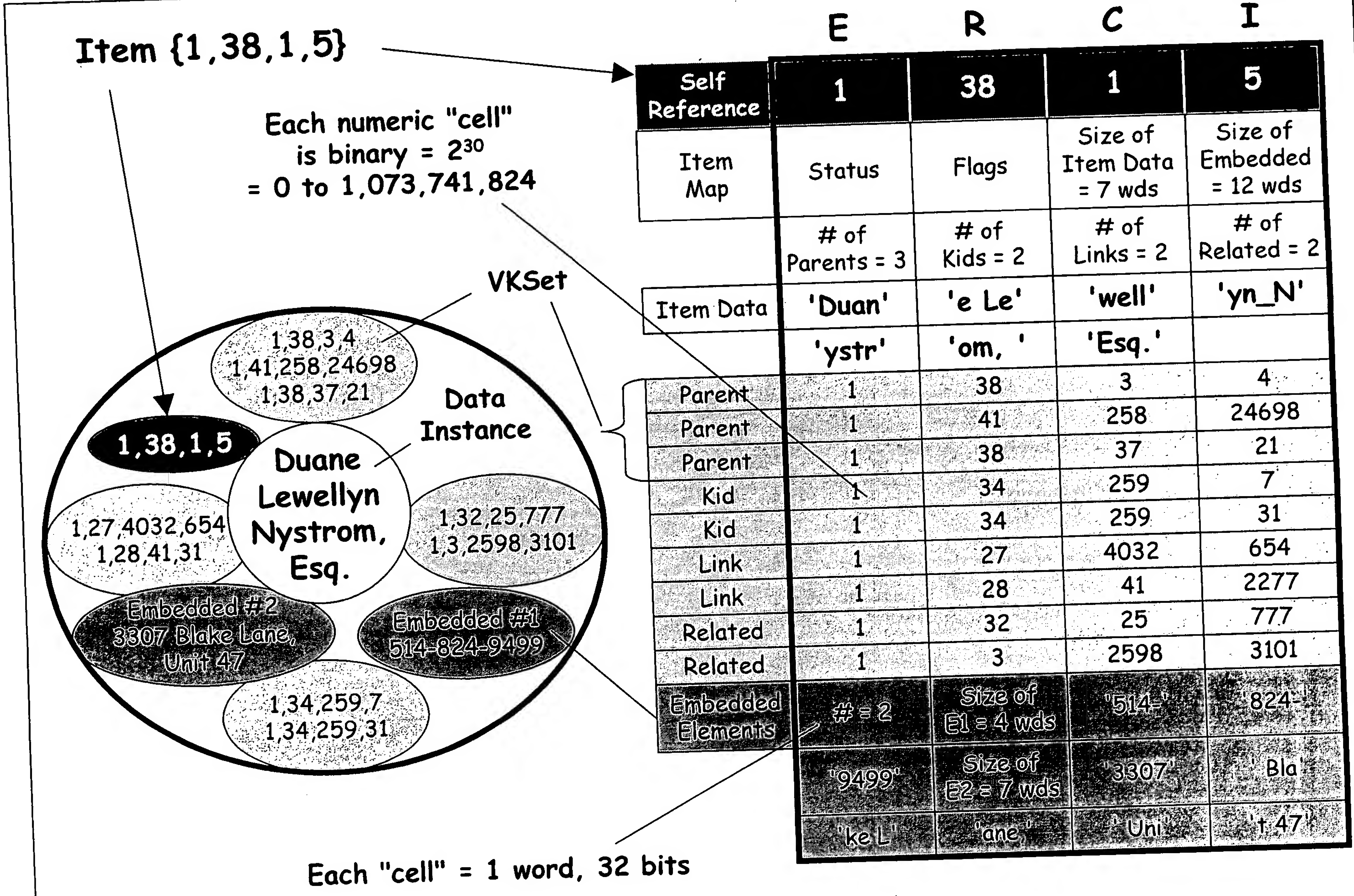
A. 'Pool' the STOCK-ORDER Context Reference {3,0} with a) all QTY Items <=2, and b) the STOCK Item 'Pinto Beans'



Drawing 11. An Example of 'Pooling'

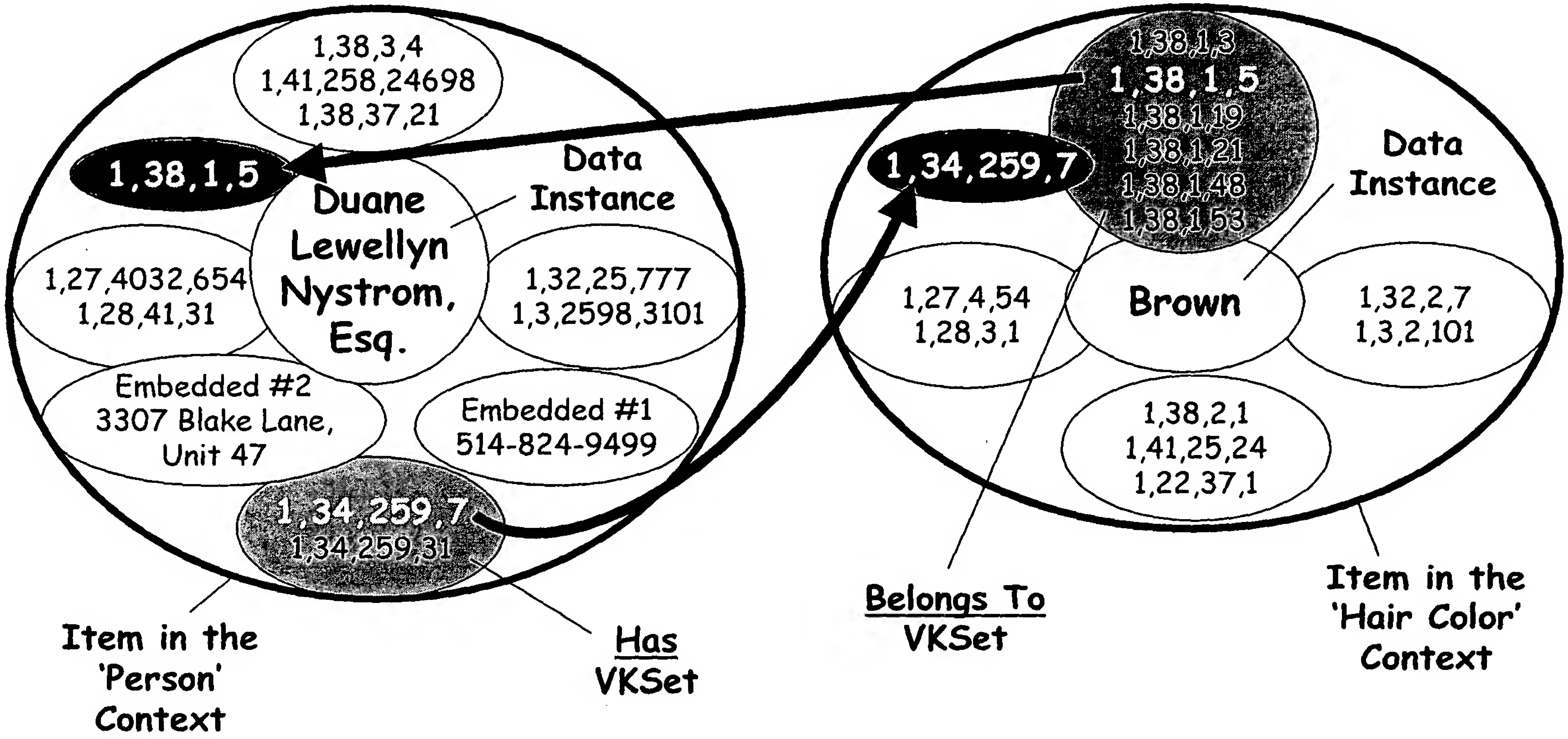


Drawing 12. Multi-Dimensional Reference Model



	E	R	C	I
Self Reference	1	38	1	5
Item Map	Status	Flags	Size of Item Data = 7 wds	Size of Embedded = 12 wds
	# of Parents = 3	# of Kids = 2	# of Links = 2	# of Related = 2
Item Data	'Duan'	'e Le'	'well'	'yn_N'
	'ystr'	'om, '	'Esq.'	
Parent	1	38	3	4
Parent	1	41	258	24698
Parent	1	38	37	21
Kid	1	34	259	7
Kid	1	34	259	31
Link	1	27	4032	654
Link	1	28	41	2277
Related	1	32	25	777
Related	1	3	2598	3101
Embedded Elements	# = 2	Size of E1 = 4 wds	'514-'	'824-'
	'9499'	Size of E2 = 7 wds	'3307'	' Bla'
	'ke L'	'ane '	' Uni'	't 47'

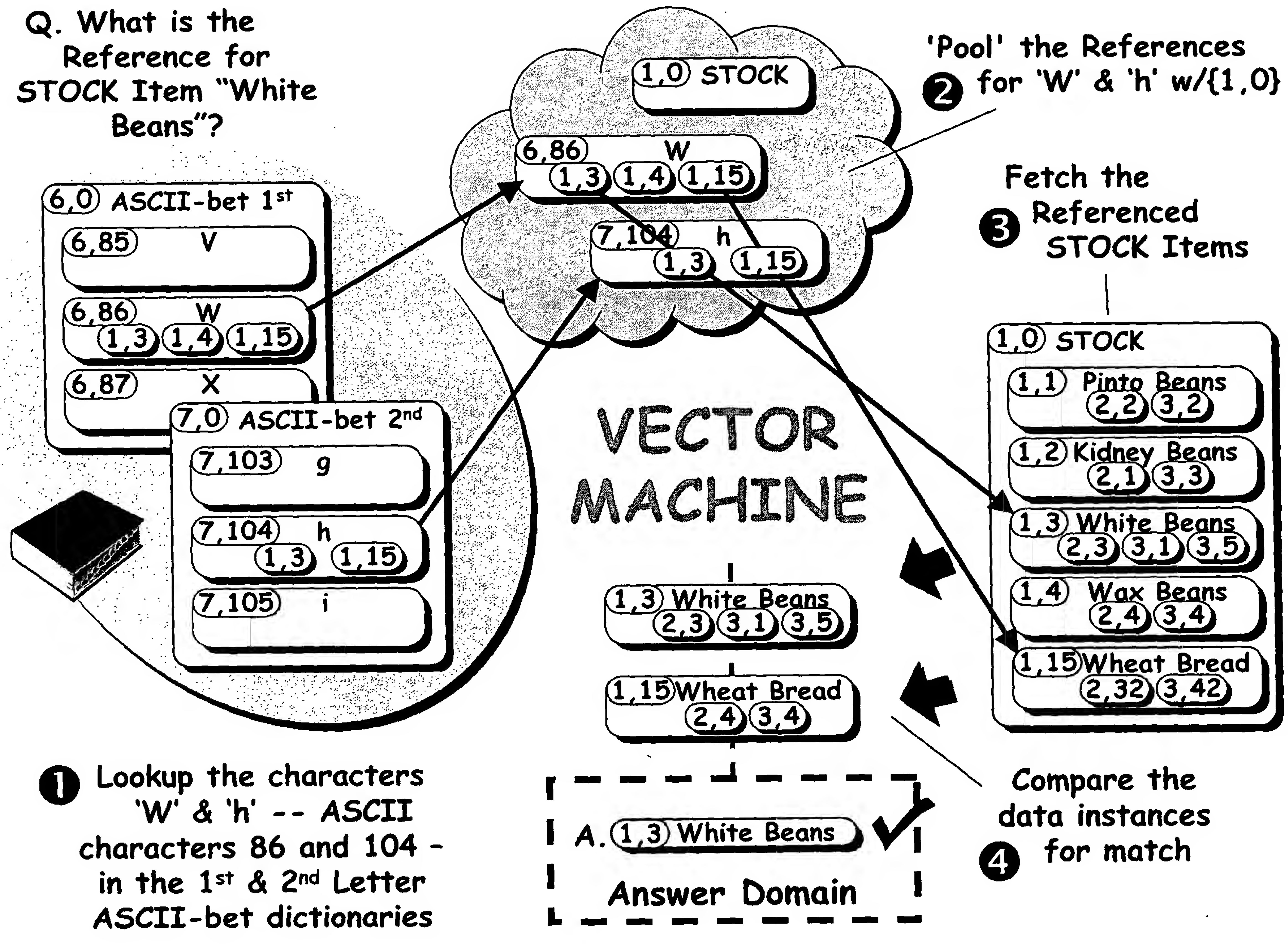
Drawing 13. Structure of a KnOS Item



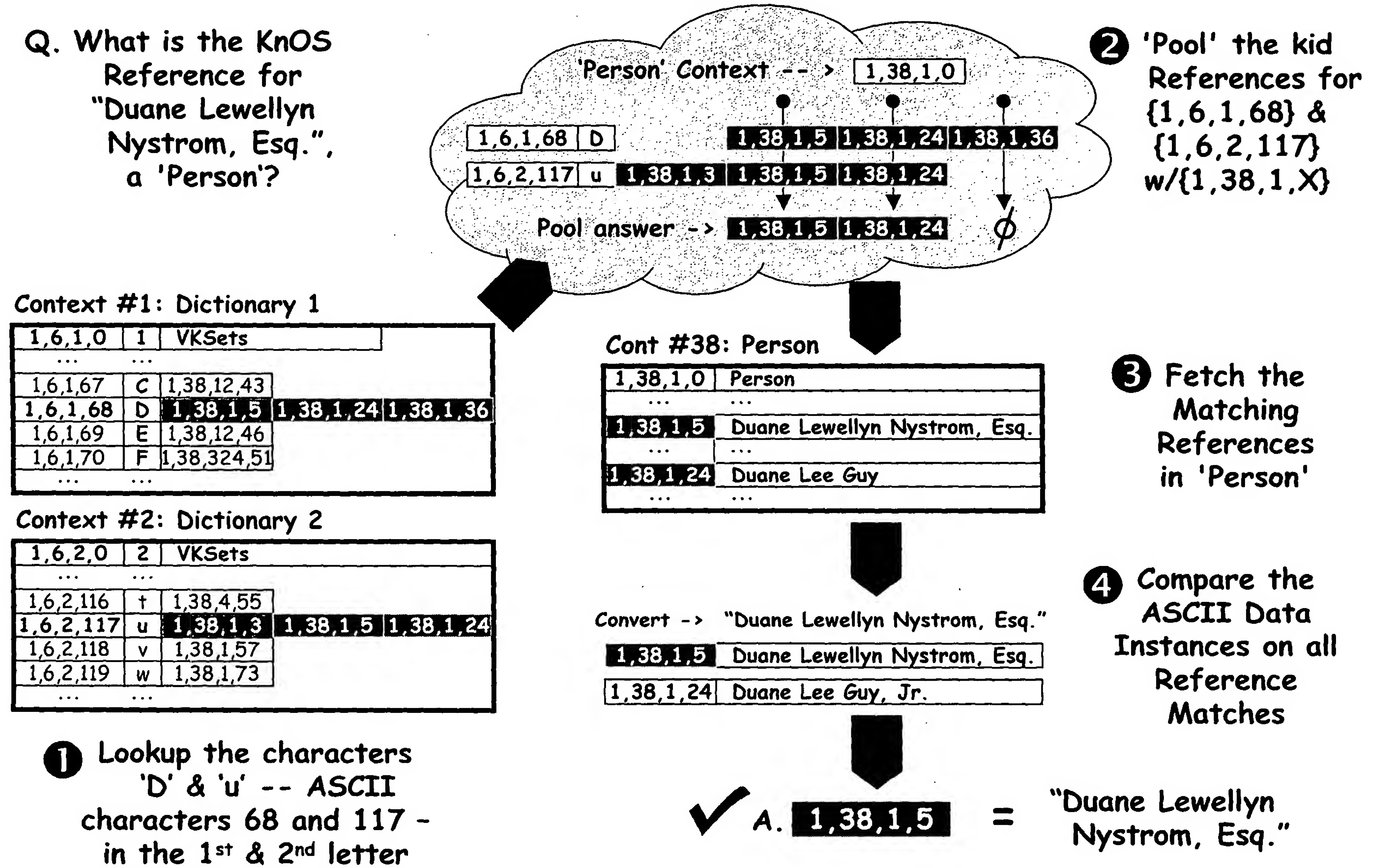
Person *Duane Lewellyn Nystrom, Esq.* has *Brown* Hair Color

Brown Hair Color belongs to Person *Duane Lewellyn Nystrom, Esq.*

Drawing 14. Bi-Directional References



Drawing 15a ASCII-betical Conversion



Q. What is the KnOS Reference for "Duane Lewellyn Nystrom, Esq.", a 'Person'?

Context #1: Dictionary 1

1,6,1,0	1	VKSets		
...	...			
1,6,1,67	C	1,38,12,43		
1,6,1,68	D	1,38,1,5	1,38,1,24	1,38,1,36
1,6,1,69	E	1,38,12,46		
1,6,1,70	F	1,38,324,51		
...	...			

Context #2: Dictionary 2

1,6,2,0	2	VKSets		
...	...			
1,6,2,116	t	1,38,4,55		
1,6,2,117	u	1,38,1,3	1,38,1,5	1,38,1,24
1,6,2,118	v	1,38,1,57		
1,6,2,119	w	1,38,1,73		
...	...			

1 Lookup the characters 'D' & 'u' -- ASCII characters 68 and 117 - in the 1st & 2nd letter ASCII-bet dictionaries

'Person' Context --> 1,38,1,0
1,6,1,68 D 1,38,1,5 1,38,1,24 1,38,1,36
1,6,2,117 u 1,38,1,3 1,38,1,5 1,38,1,24
Pool answer -> 1,38,1,5 1,38,1,24 ϕ

2 'Pool' the kid References for {1,6,1,68} & {1,6,2,117} w/{1,38,1,X}

Cont #38: Person

1,38,1,0	Person
...	...
1,38,1,5	Duane Lewellyn Nystrom, Esq.
...	...
1,38,1,24	Duane Lee Guy
...	...

3 Fetch the Matching References in 'Person'

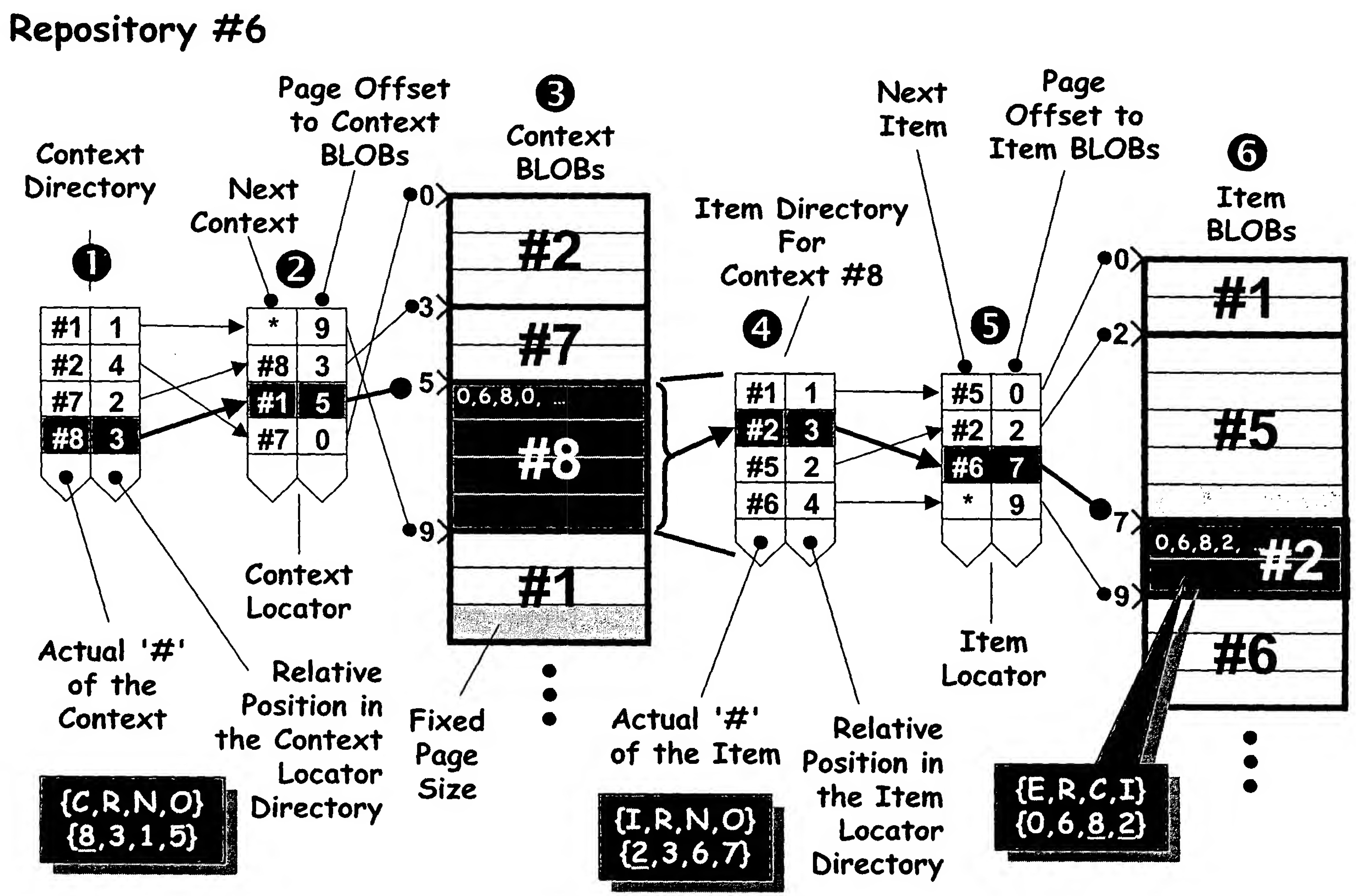
Convert -> "Duane Lewellyn Nystrom, Esq."

1,38,1,5	Duane Lewellyn Nystrom, Esq.
1,38,1,24	Duane Lee Guy, Jr.

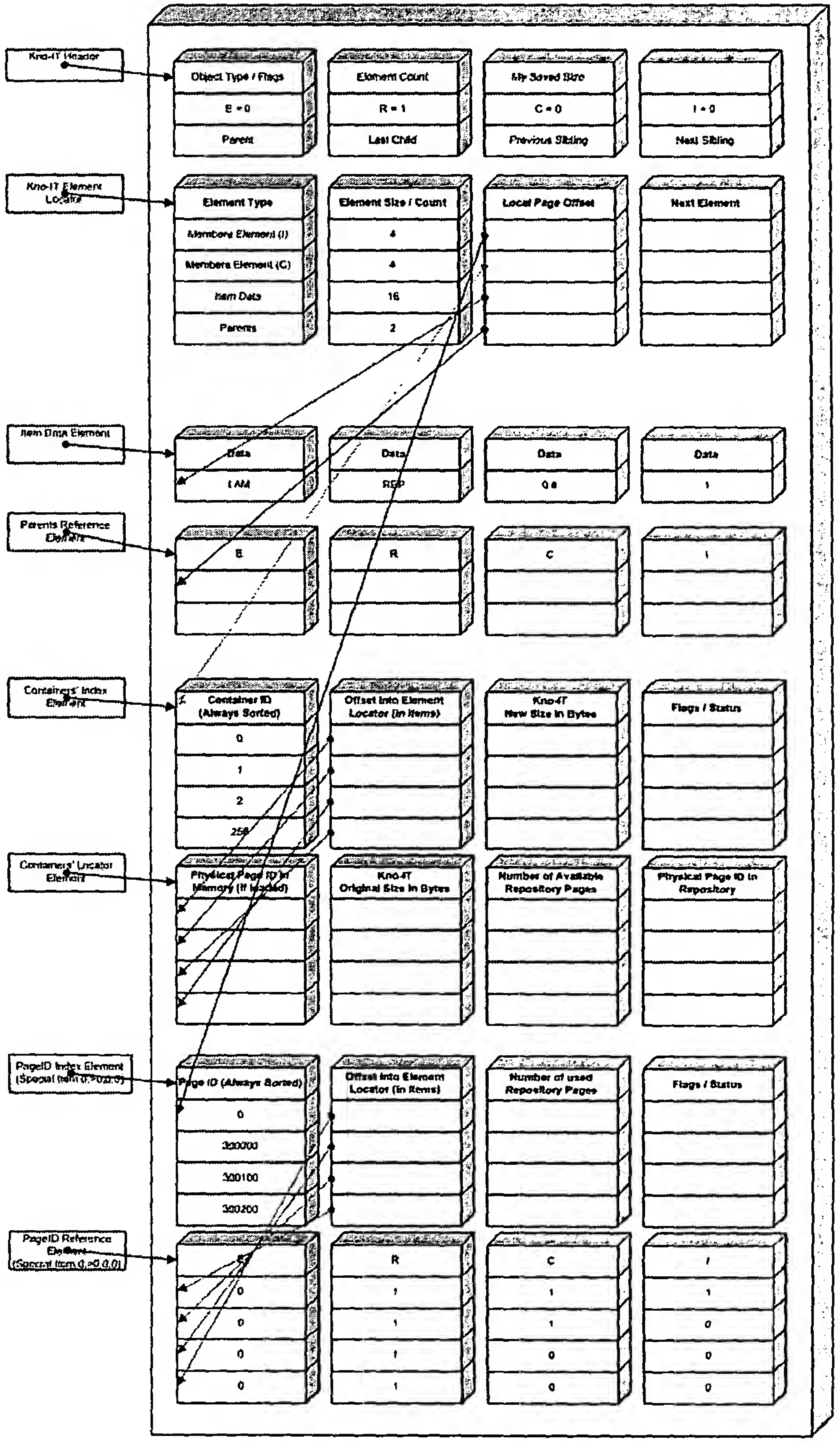
4 Compare the ASCII Data Instances on all Reference Matches

✓ A. 1,38,1,5 = "Duane Lewellyn Nystrom, Esq."

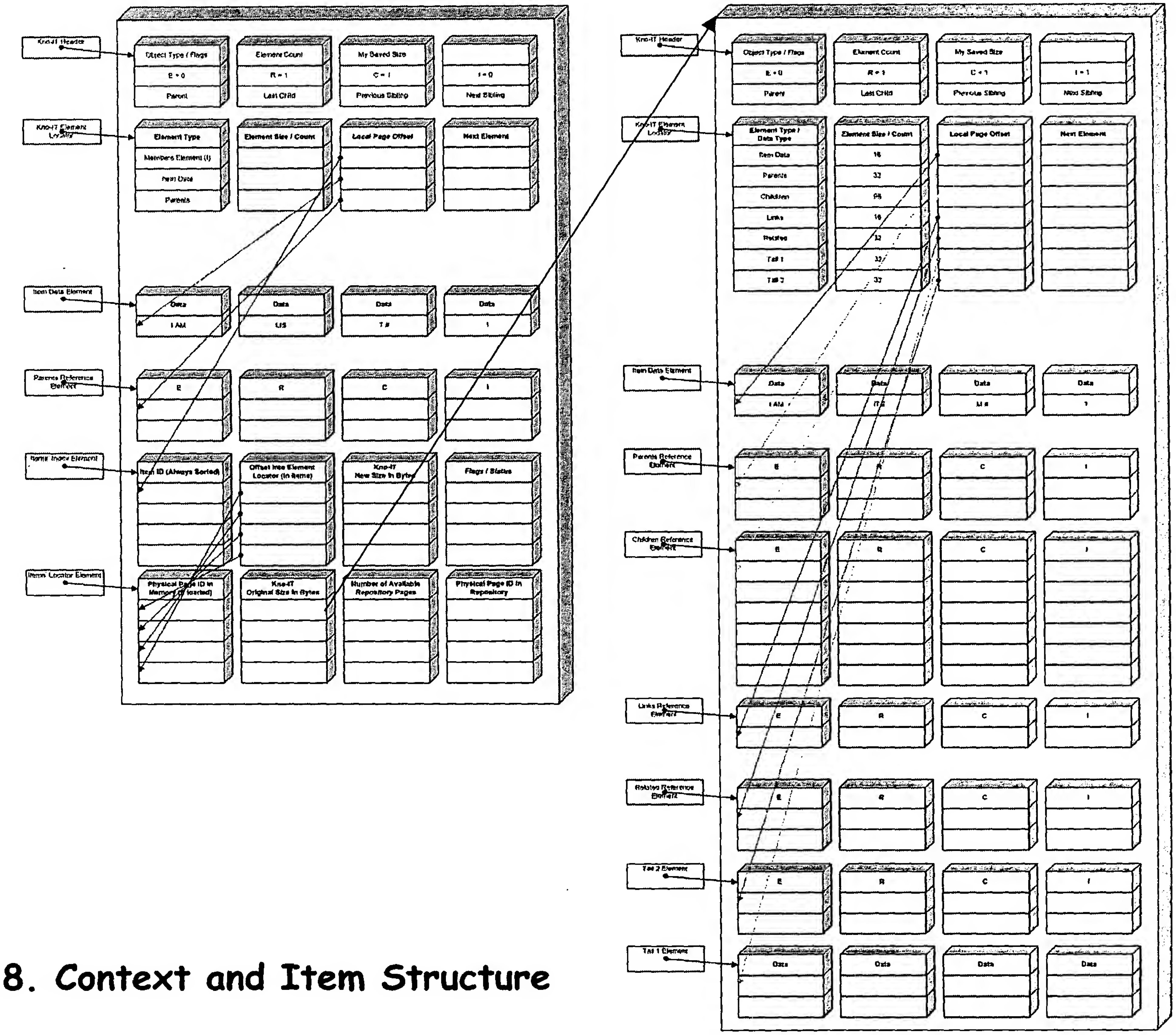
Drawing 15b ASCII-betical Conversion



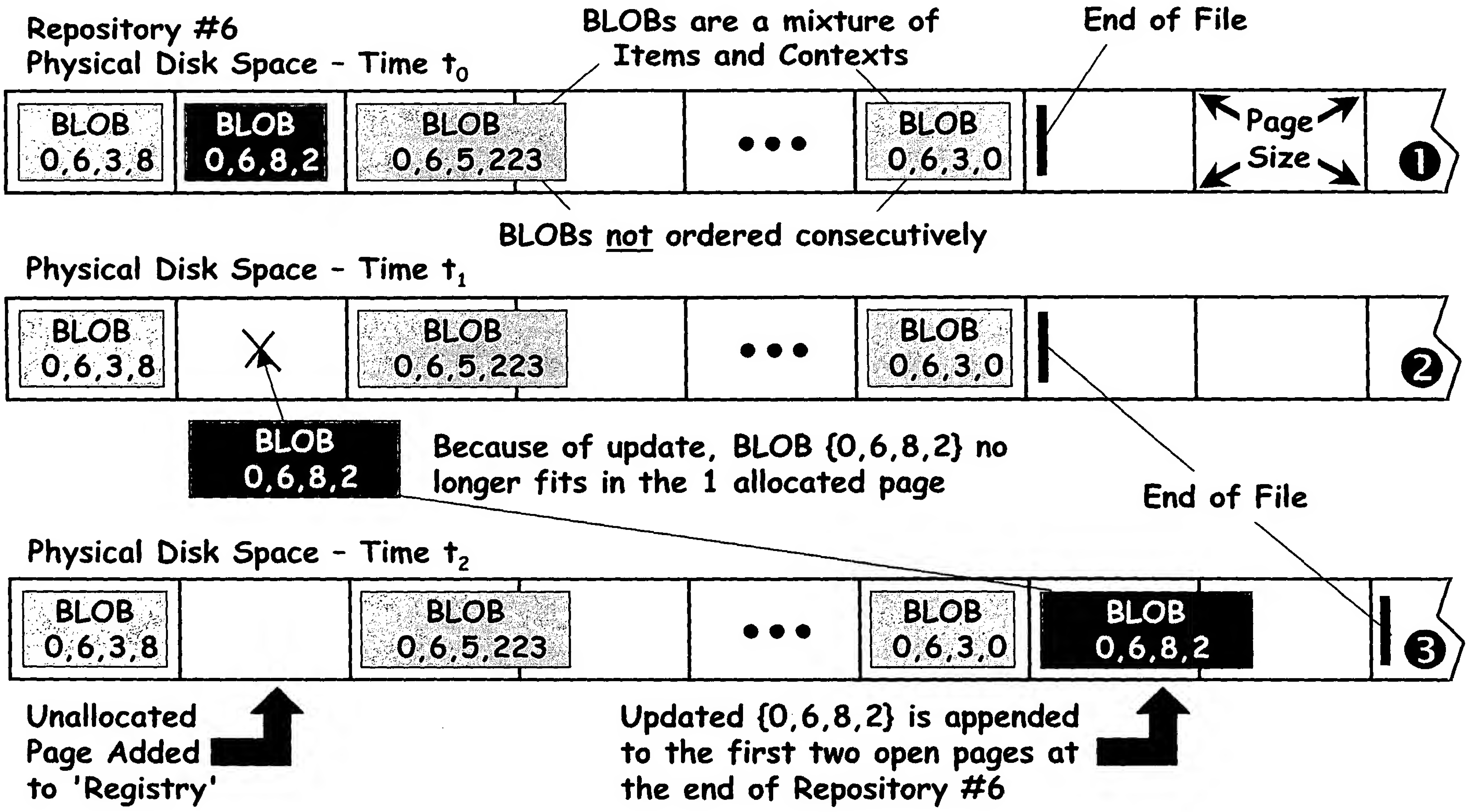
Drawing 16. Locating Item {0,6,8,2} on the Physical Media


Kno-IT Header
Object Type / Flags
E = 0
Parent
Element Count
R = 1
Last Child
My Saved Size
C = 0
Previous Sibling
I = 0
Next Sibling
Kno-IT Element Locator
Element Type
Members Element (I)
Members Element (C)
Item Data
Parents
Element Size / Count
4
4
16
2
Local Page Offset
Next Element
Item Data Element
Data
I AM
Data
REP
Data
Q #
Data
1
Parents Reference Element
E
R
C
I
Containers' Index Element
Container ID (Always Sorted)
0
1
2
256
Offset into Element Locator (in Items)
Kno-IT New Size in Bytes
Flags / Status
Containers' Locator Element
Physical Page ID in Memory (If loaded)
Kno-IT Original Size in Bytes
Number of Available Repository Pages
Physical Page ID in Repository
PageID Index Element (Special Item 0,>0,0,0)
Page ID (Always Sorted)
0
300000
300100
300200
Offset into Element Locator (in Items)
Number of used Repository Pages
Flags / Status
PageID Reference Element (Special Item 0,>0,0,0)
E
0
0
0
0
R
1
1
1
1
C
1
1
0
0
I
1
0
0
0

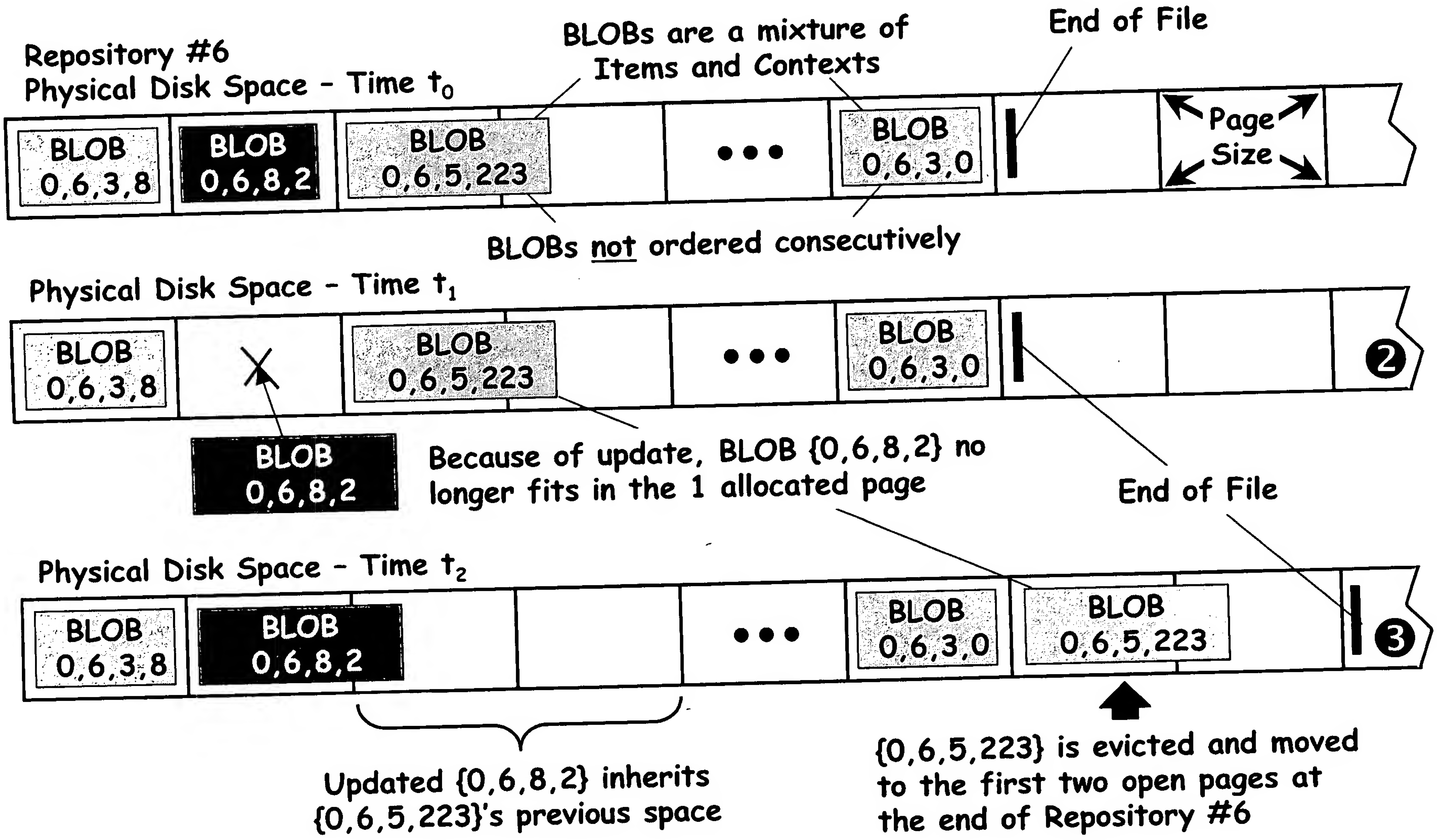
Drawing 17. Repository Structure



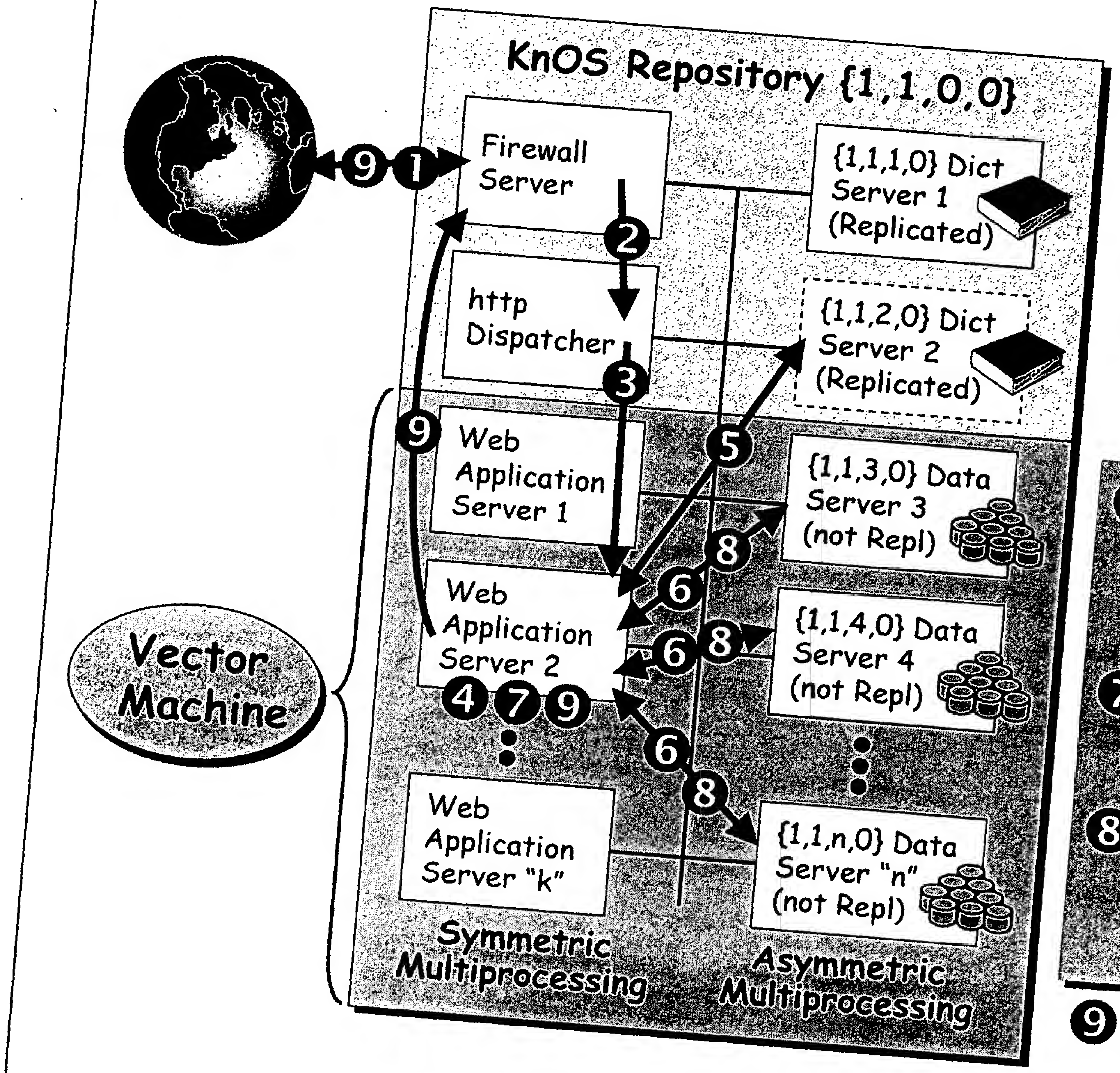
Drawing 18. Context and Item Structure


Repository #6
Physical Disk Space - Time t_0
BLOBs are a mixture of Items and Contexts
End of File
BLOB 0,6,3,8
BLOB 0,6,8,2
BLOB 0,6,5,223
•••
BLOB 0,6,3,0
Page Size
1
BLOBs not ordered consecutively
Physical Disk Space - Time t_1
BLOB 0,6,3,8
BLOB 0,6,5,223
•••
BLOB 0,6,3,0
2
BLOB 0,6,8,2
Because of update, BLOB {0,6,8,2} no longer fits in the 1 allocated page
End of File
Physical Disk Space - Time t_2
BLOB 0,6,3,8
BLOB 0,6,5,223
•••
BLOB 0,6,3,0
BLOB 0,6,8,2
3
Unallocated Page Added to 'Registry'
Updated {0,6,8,2} is appended to the first two open pages at the end of Repository #6

Drawing 19. Updating Item {0,6,8,2} on the Physical Media - I


Repository #6
Physical Disk Space - Time t_0
BLOBs are a mixture of Items and Contexts
End of File
BLOB 0,6,3,8
BLOB 0,6,8,2
BLOB 0,6,5,223
BLOB 0,6,3,0
Page Size
BLOBs not ordered consecutively
Physical Disk Space - Time t_1
BLOB 0,6,3,8
BLOB 0,6,5,223
BLOB 0,6,3,0
2
BLOB 0,6,8,2
Because of update, BLOB {0,6,8,2} no longer fits in the 1 allocated page
End of File
Physical Disk Space - Time t_2
BLOB 0,6,3,8
BLOB 0,6,8,2
BLOB 0,6,3,0
BLOB 0,6,5,223
3
Updated {0,6,8,2} inherits {0,6,5,223}'s previous space
{0,6,5,223} is evicted and moved to the first two open pages at the end of Repository #6

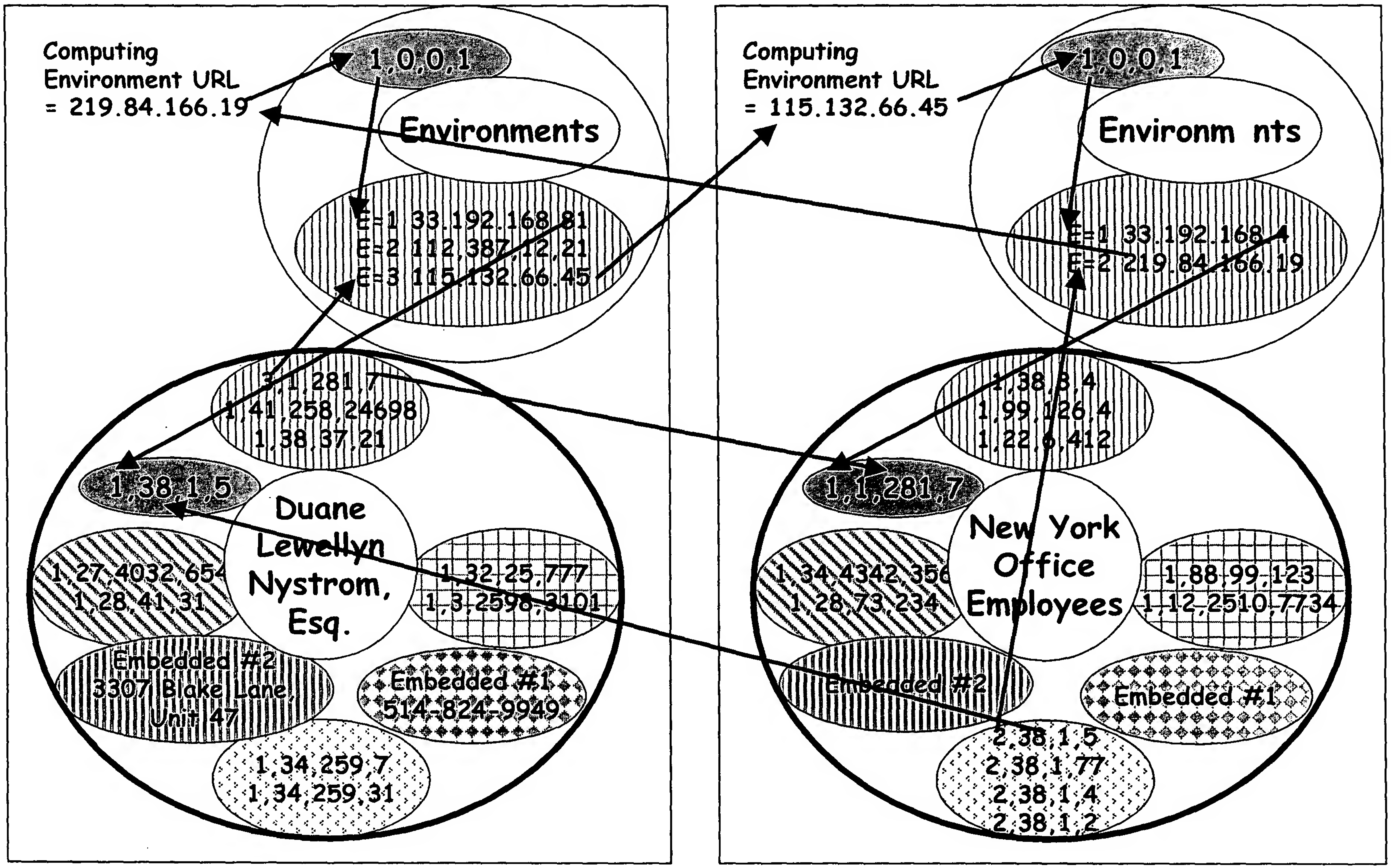
Drawing 20. Updating Item {0,6,8,2} on the Physical Media - II


KnOS Repository {1,1,0,0}
Firewall Server
http Dispatcher
Web Application Server 1
Web Application Server 2
Web Application Server "k"
{1,1,1,0} Dict Server 1 (Replicated)
{1,1,2,0} Dict Server 2 (Replicated)
{1,1,3,0} Data Server 3 (not Repl)
{1,1,4,0} Data Server 4 (not Repl)
{1,1,n,0} Data Server "n" (not Repl)
Symmetric Multiprocessing
Asymmetric Multiprocessing
Vector Machine
9
1
2
3
4
5
6
7
8
9

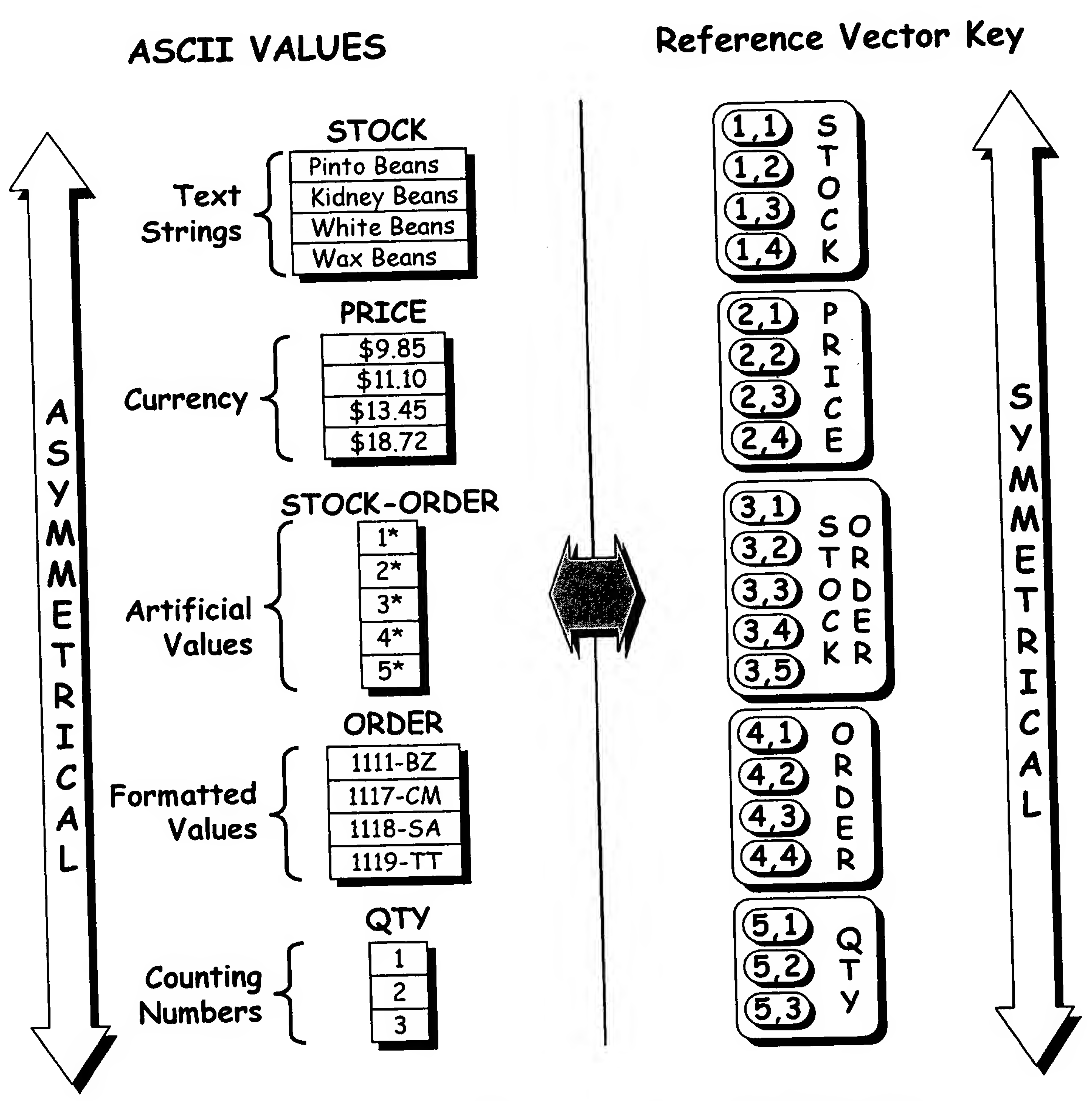
Typical Query Transaction

1. Receives http over Internet
2. Forwards to http Dispatcher
3. Authenticates credentials & Dispatches to #2 Web Application Server (based on idle capacity)
4. Parses http/html, establishes session
5. Tasks Dictionary {1,1,2,0} to convert transaction parameters; Dictionary {1,1,2,0} returns requested *References*
6. Issues *Referenced* fetches to {1,1,3,0} to {1,1,n,0}; {1,1,3,0} to {1,1,n,0} fetch & return Items containing all potentially-relevant data
7. Performs vector operations --> Repeats 6 and 7 until completion of the transaction
8. Issues *Referenced* fetches to {1,1,3,0} to {1,1,n,0} for answers; {1,1,3,0} to {1,1,n,0} fetch & return the Items
9. Packages response in http/XML & replies to requester via firewall

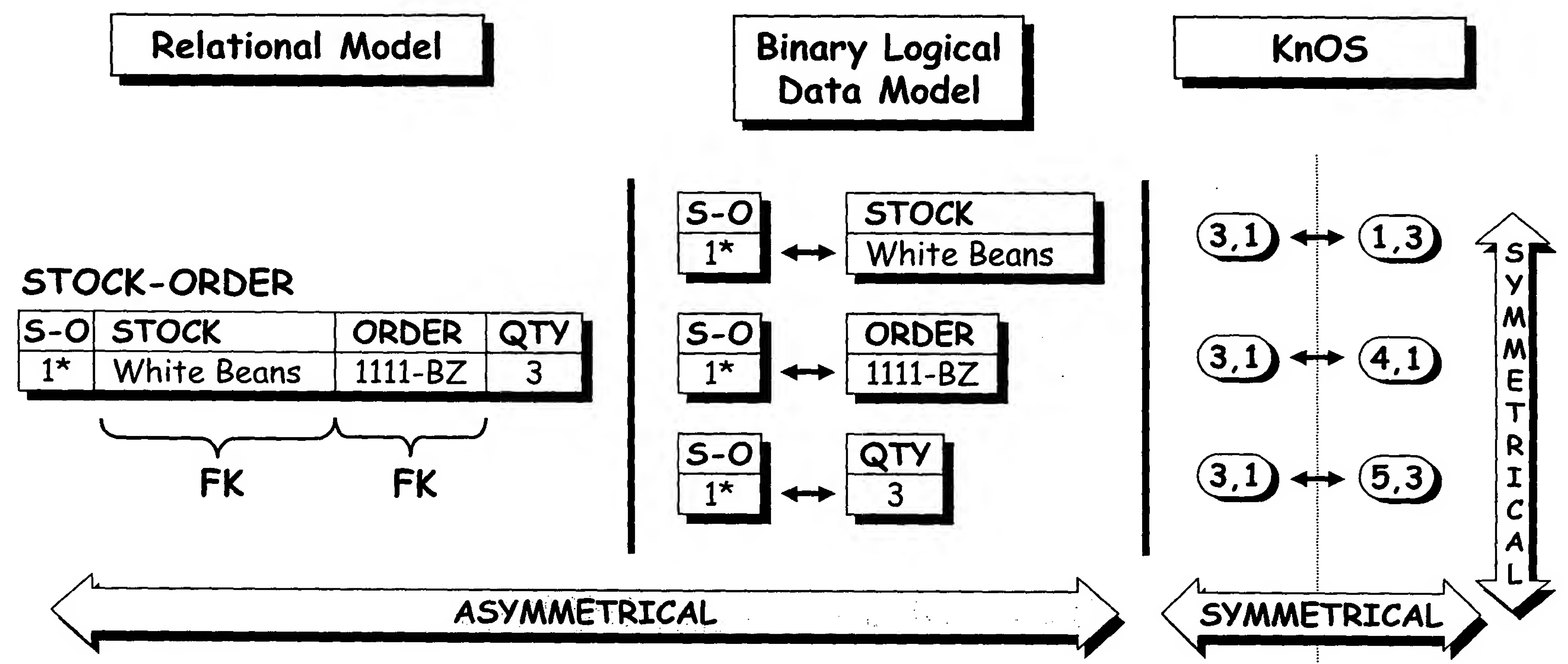
Drawing 21. KnOS Scalability



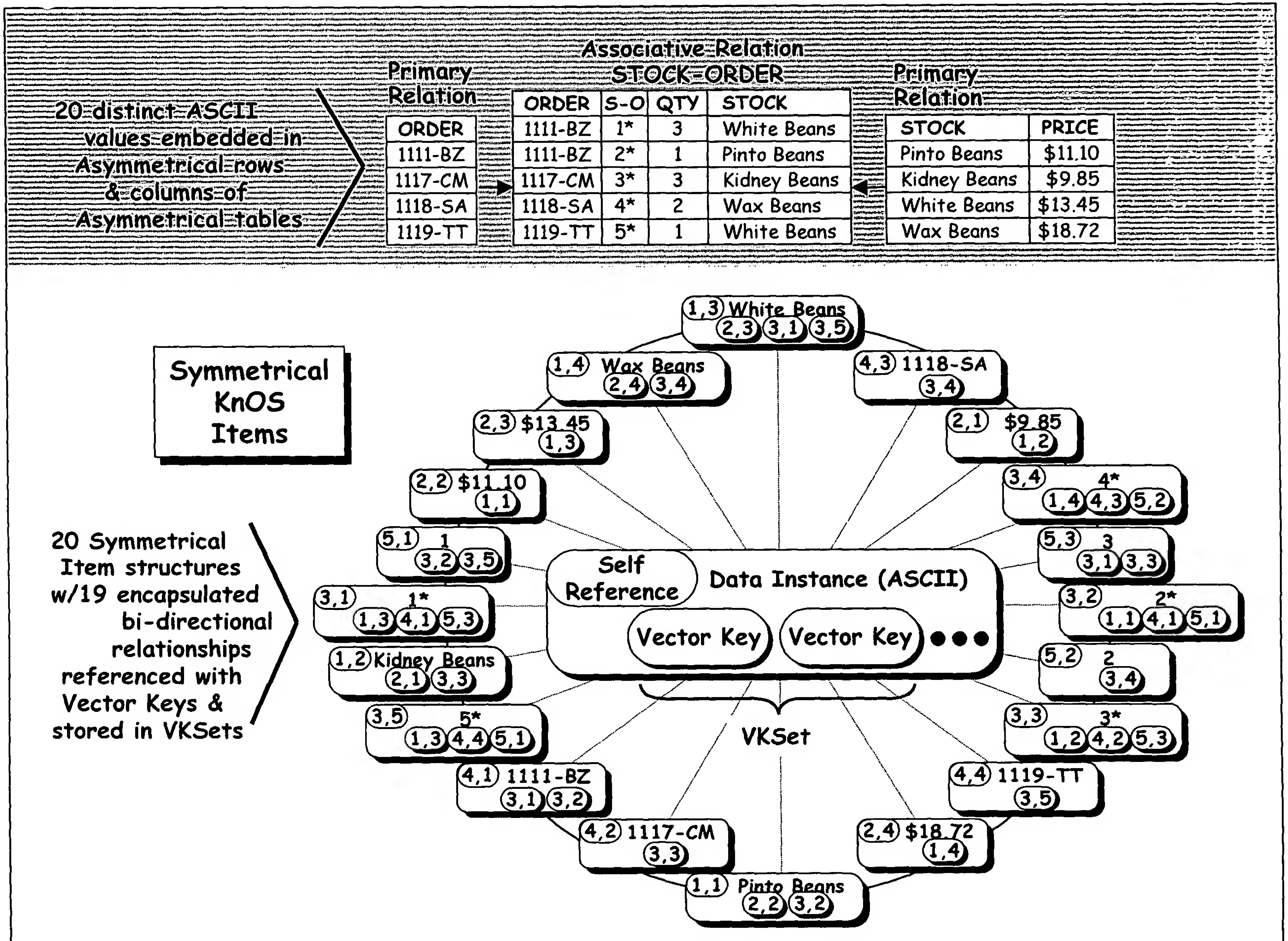
Drawing 22. Inter-Referencing between Computing Environments



Drawing 23. *Value Symmetry*



Drawing 24. *Relationship Symmetry*



20 distinct ASCII values embedded in Asymmetrical rows & columns of Asymmetrical tables

Primary Relation

ORDER
1111-BZ
1117-CM
1118-SA
1119-TT

Associative Relation STOCK-ORDER

ORDER	S-O	QTY	STOCK
1111-BZ	1*	3	White Beans
1111-BZ	2*	1	Pinto Beans
1117-CM	3*	3	Kidney Beans
1118-SA	4*	2	Wax Beans
1119-TT	5*	1	White Beans

Primary Relation

STOCK	PRICE
Pinto Beans	$11.10
Kidney Beans	$9.85
White Beans	$13.45
Wax Beans	$18.72

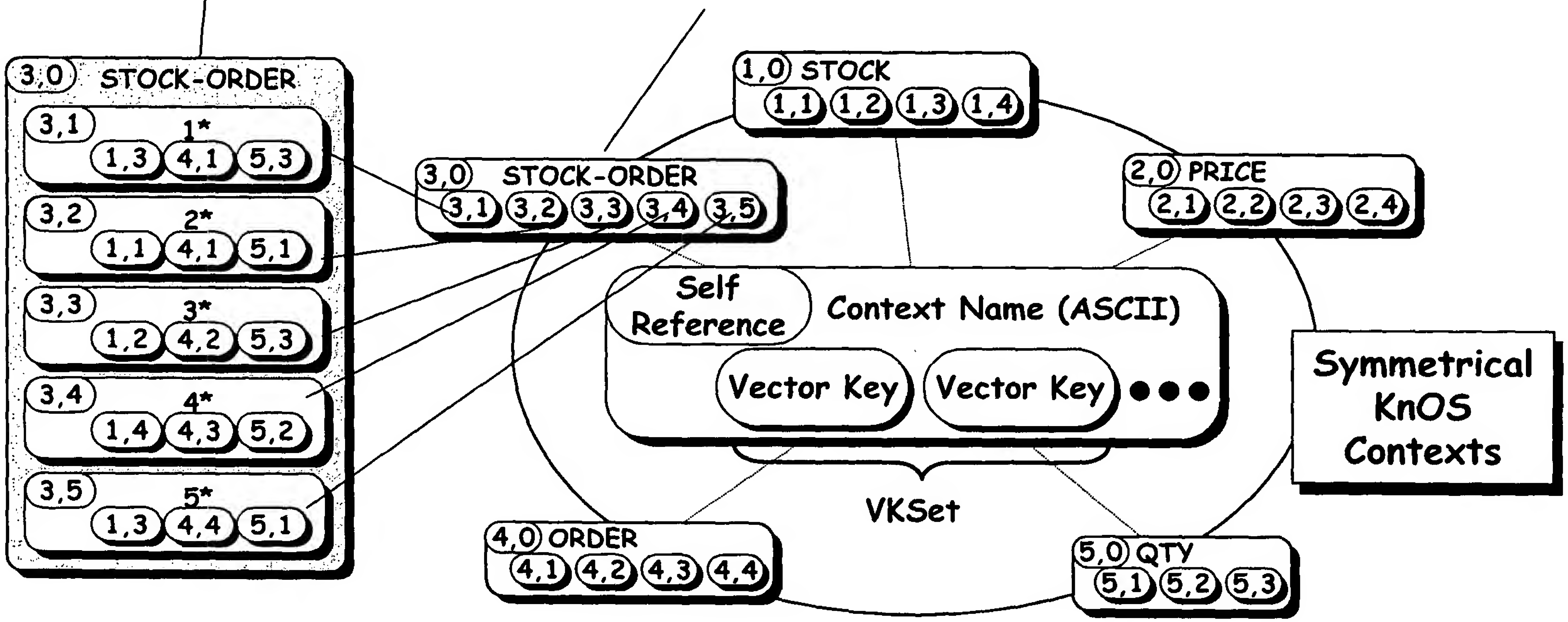
Symmetrical KnOS Items

20 Symmetrical Item structures w/19 encapsulated bi-directional relationships referenced with Vector Keys & stored in VKSets

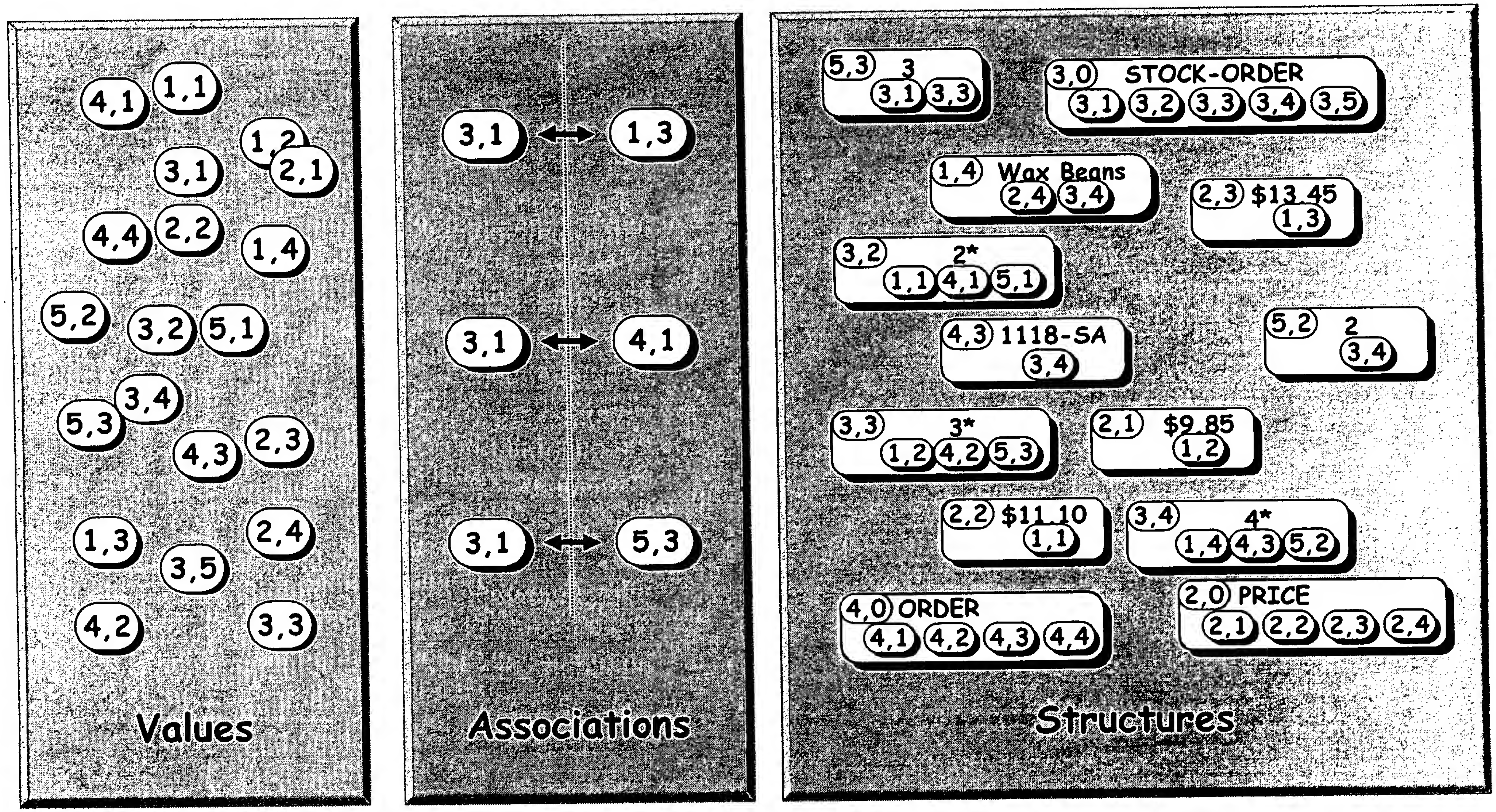
Drawing 25. *Structural* Symmetry - KnOS Items

Notionally, the *Context*, in this case STOCK-ORDER, physically Encapsulates the dependent Items, as shown here ....

In fact, *Contexts* look like Items, with self-references, *Context* names and associations, expressed as Vector Keys (VK) and stored in VKSets. The Vector Keys point to all of the Items in the given *Context*.



Drawing 26. *Structural* Symmetry - KnOS Contexts



Drawing 27. KnOS Symmetry

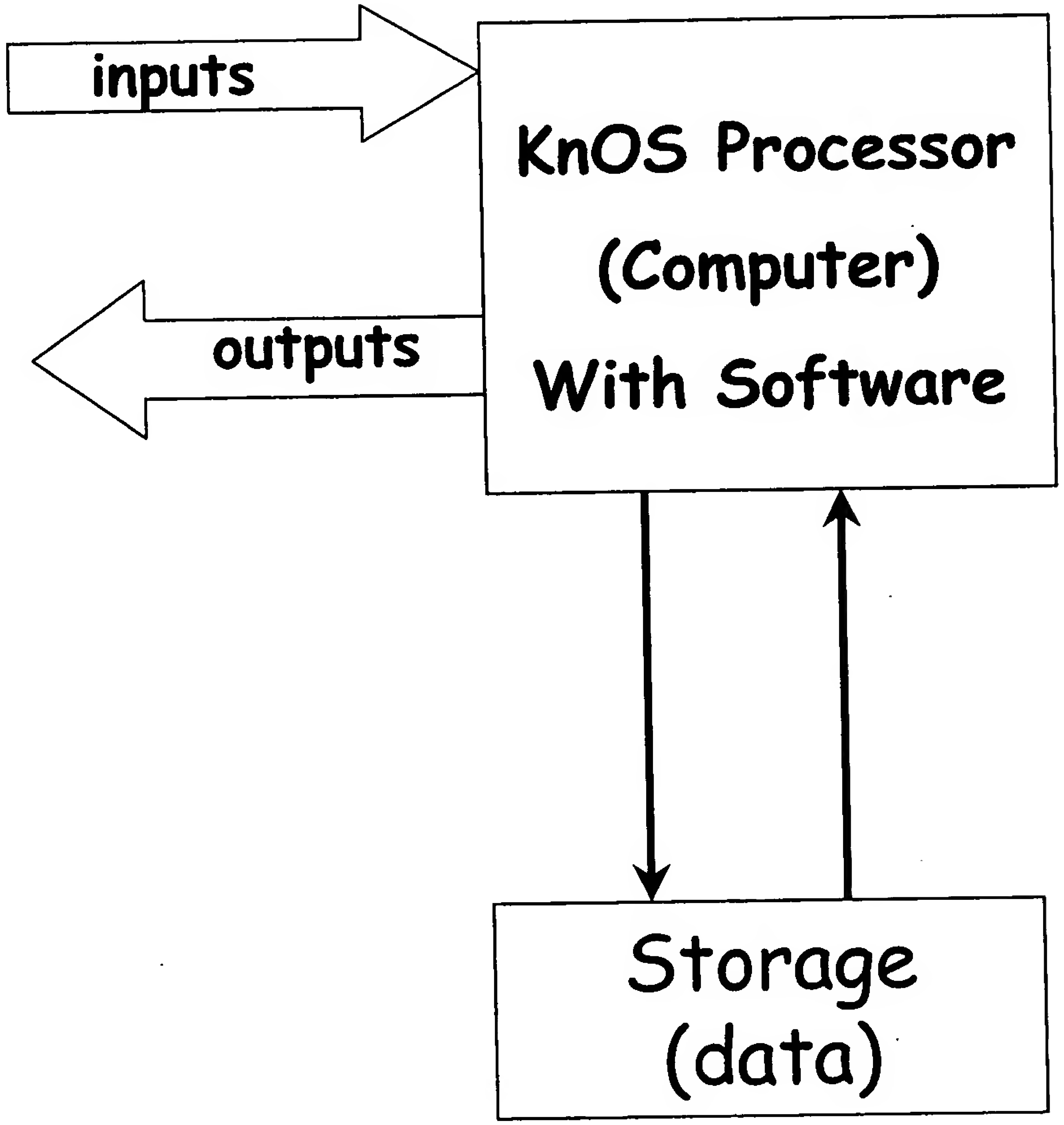

inputs
outputs
KnOS Processor
(Computer)
With Software
Storage
(data)

Figure 28

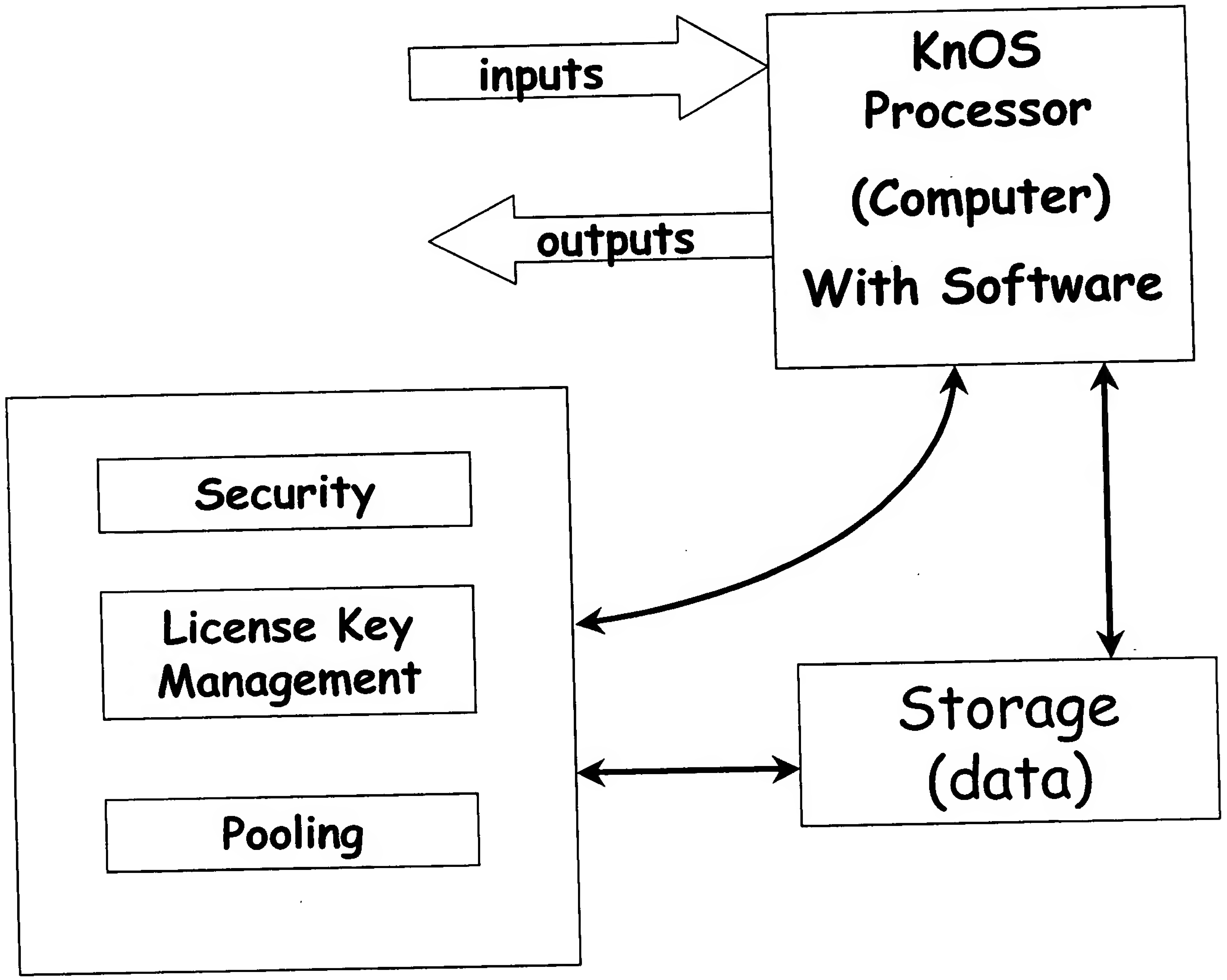
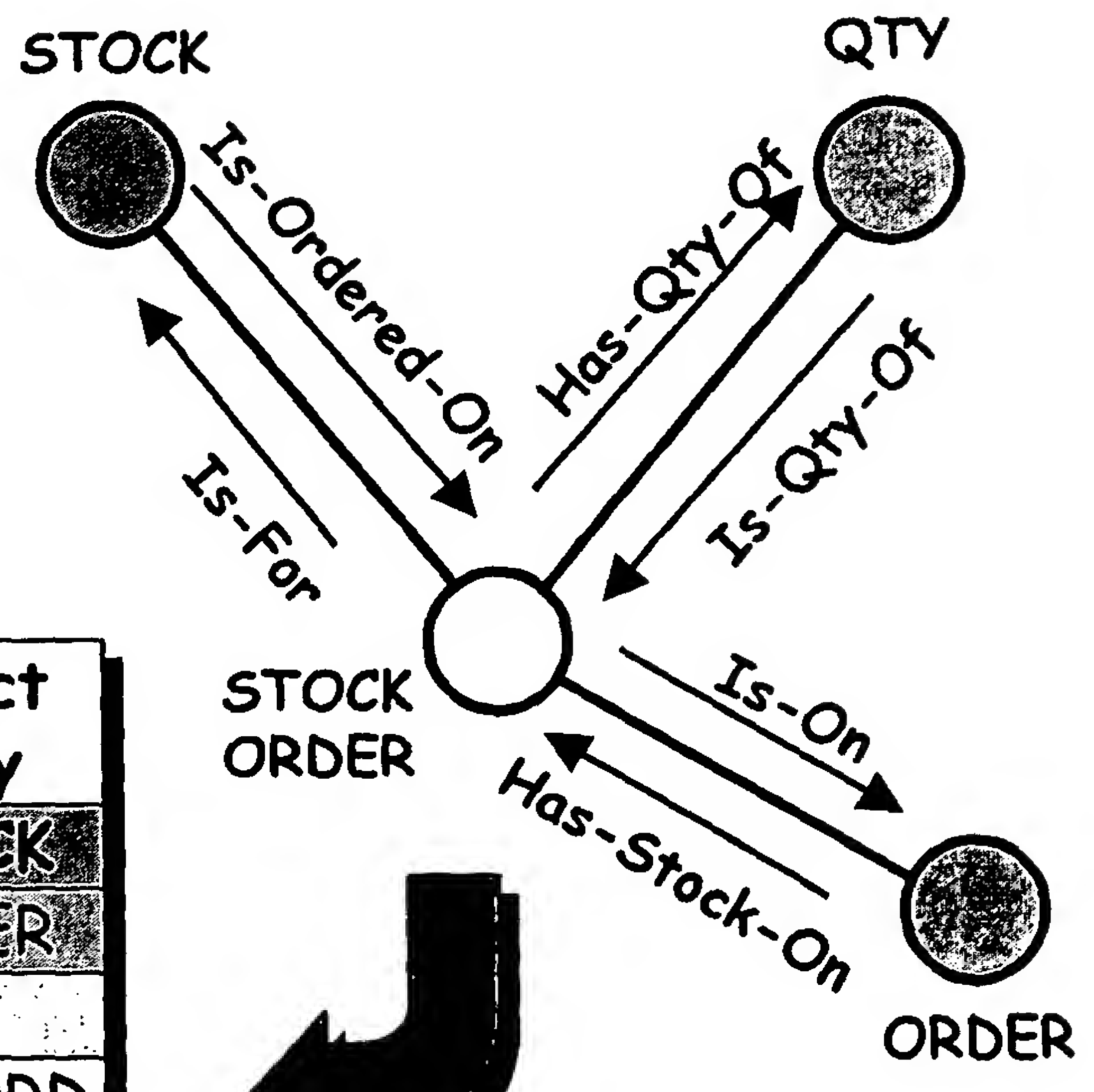

inputs
outputs
KnOS
Processor
(Computer)
With Software
Security
License Key
Management
Pooling
Storage
(data)

Figure 29

Relational Model

one tuple of STOCK-ORDER

SO	ORDER	QTY	STOCK
1*	1111-BZ	3	White Beans



Binary Data Model in Relational Format

Type Classifications

Subject Entity	Verb Phrase	Object Entity
ST-ORD	Is-For	STOCK
ST-ORD	Is-On	ORDER
ST-ORD	Has-Qty-Of	QTY
STOCK	Is-Ordered-On	ST-ORD
ORDER	Has-Stock-On	ST-ORD
QTY	Is-Qty-Of	ST-ORD

Entities

Entity	Item
STOCK	White Beans
STOCK-ORDER	1*
ORDER	1111-BZ
QTY	3

Associations

Subject Entity	Subject Item	Verb Phrase	Object Entity	Object Item
ST-ORD	1*	Is-For	STOCK	White Beans
ST-ORD	1*	Is-On	ORDER	1111-BZ
ST-ORD	1*	Has-Qty-Of	QTY	3
STOCK	White Beans	Is-Ordered-On	ST-ORD	1*
ORDER	1111-BZ	Has-Stock-On	ST-ORD	1*
QTY	3	Is-Qty-Of	ST-ORD	1*

Figure 30 (Prior Art)

A Comparison of Compactness